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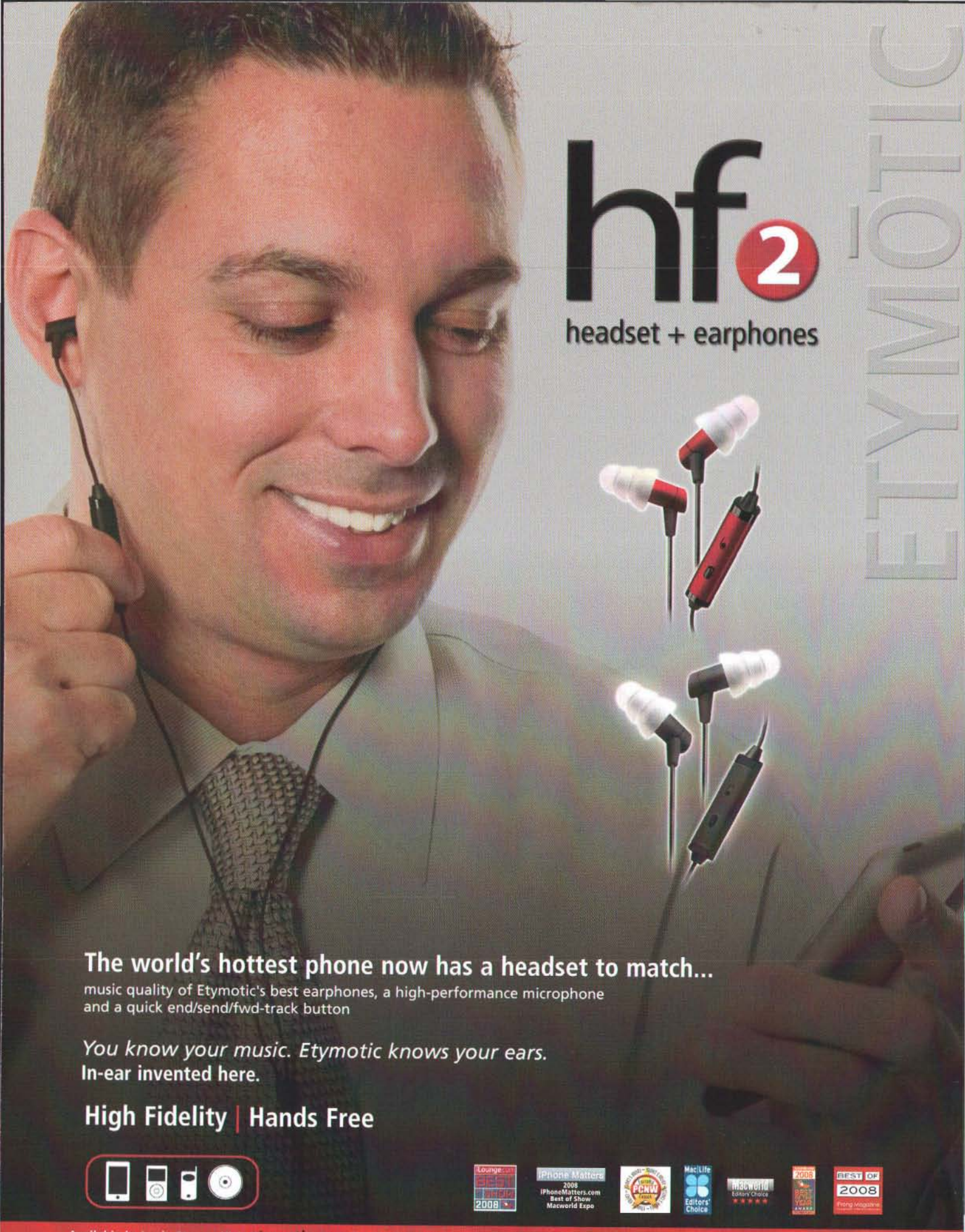
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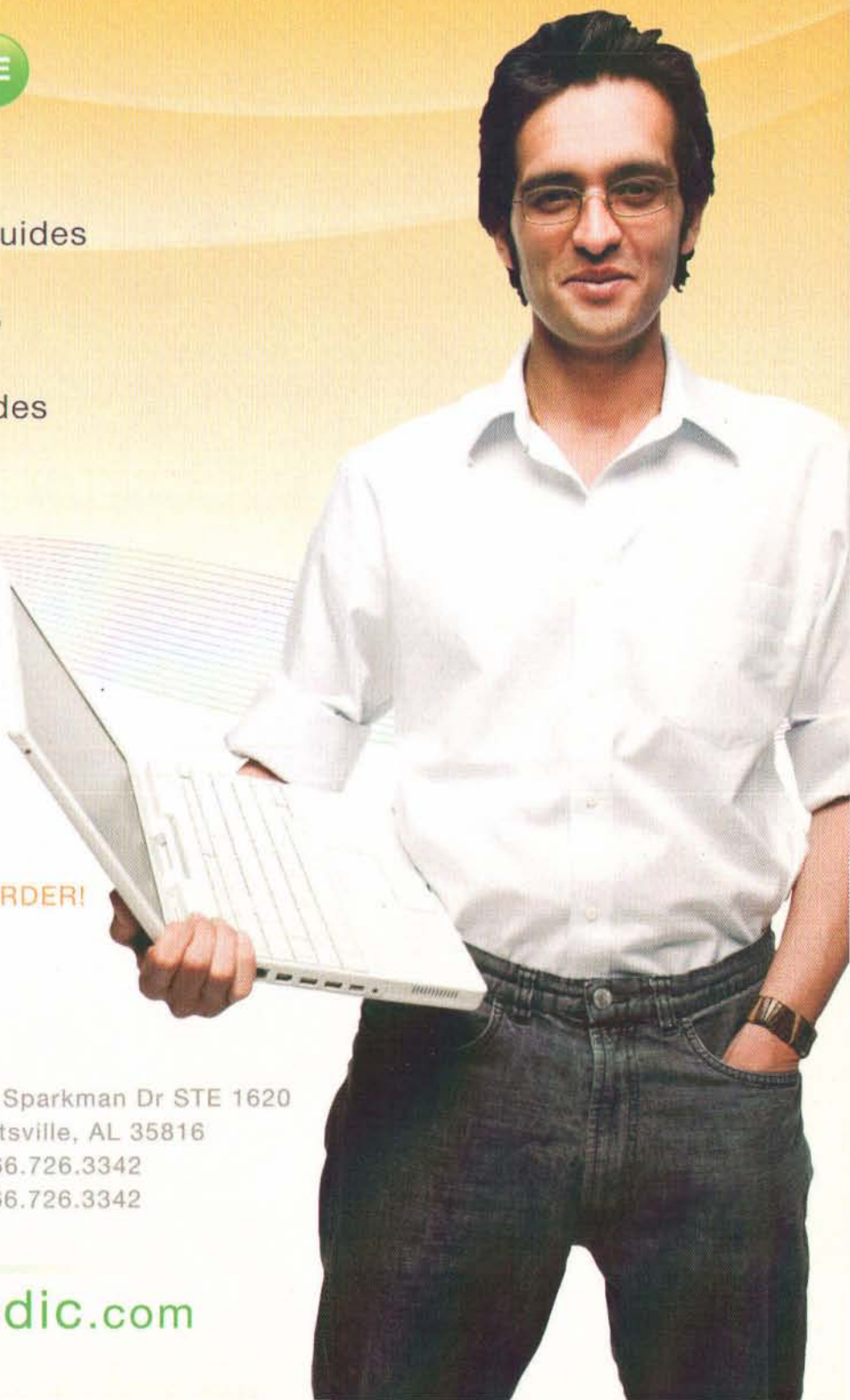

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# From the Editor

**2009 ticks along** and it might be time to review your tech New Year resolutions. What are you doing to improve your skills and offer more? It's a question that you continually need to ask yourself. Learning a new API, learning a new language or learning a new technique are all parts of a continual cycle. Exposure to that which is just outside of your comfort zone works wonders for an assistive push. It takes a bit of an open mind, though. We think the articles presented this month should help with all of the above.

Our cover story this month is Unity3D, and game development environment. Like the Torque Engine that we recently covered, Unity3D allows a creator to design an interactive environment without needing to learn C or C++. Better yet is that Unity3D also has a module that allows development for the iPhone—several of the top game titles on the App Store have been developed with Unity3D. Let author Will Goldstone guide you through the basics of this unique utility.

On the security front, new MacTech author Rich Trouton compares several methods and products for protecting data on disk. Despite many of the protections that you can take with your data, you may be vulnerable in ways that you don't expect. For example, there are certain data that are exposed in cache data – often placed outside of your home directory. This month's "Macintosh Data Encryption" article shows you ways to protect this data, too.

Another new-to-MacTech author, William Smith, a Microsoft MVP (not a Microsoft employee) delves into Exchange's mail protocols, some changes that they've gone through and how they behave with Entourage. Or, as the subtitle says, "[w]hat administrators need to know about Microsoft's newest E-mail protocol."

Greg Neagle covers various ways to integrate your Mac with Active Directory in this month's MacEnterprise article. If you haven't run into Active Directory, there's a pretty high chance you will, as it's popular for several reasons. One of which is that it's a robust, reliable directory (so, give it a chance!).

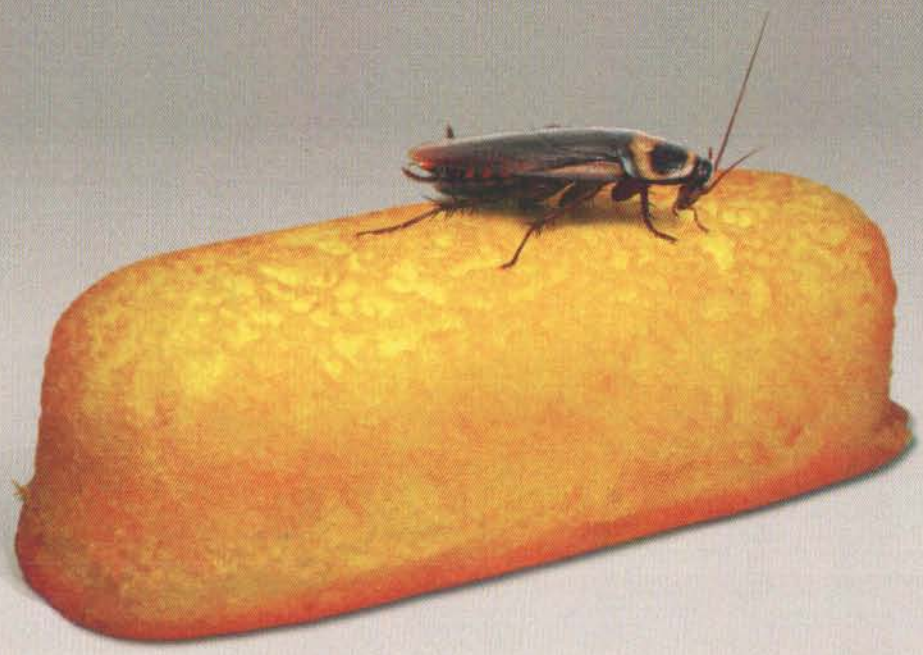
Dave Dribin continues the Road to Code by getting into more GUI territory. Learn about NSViews: what they are and how you can press them into service.

The Mac in the Shell column has been introducing you to Python on the Mac. This month introduces you to object oriented programming (OOP) in Python. It's a little unlike OOP in other languages, so, even if you think you've seen it before, if you're new to Python, it's worth delving into.

Finally, our extensive Virtual Machine benchmarks are here for your reference. We pitted Parallels against VMWare in real world tests. What are "real world tests?" Well, rather than simply running a benchmark suite like Geekbench, we simulated activities that a typical end user may perform on a daily basis (like Application launch times, document scrolling performance, etc.).

Here's hoping that we're helping you fulfill your own tech resolutions. Have topics you'd like to see covered? Just let us know at letters@mactech.com. See you next month!

Edward Marczak,
Executive Editor



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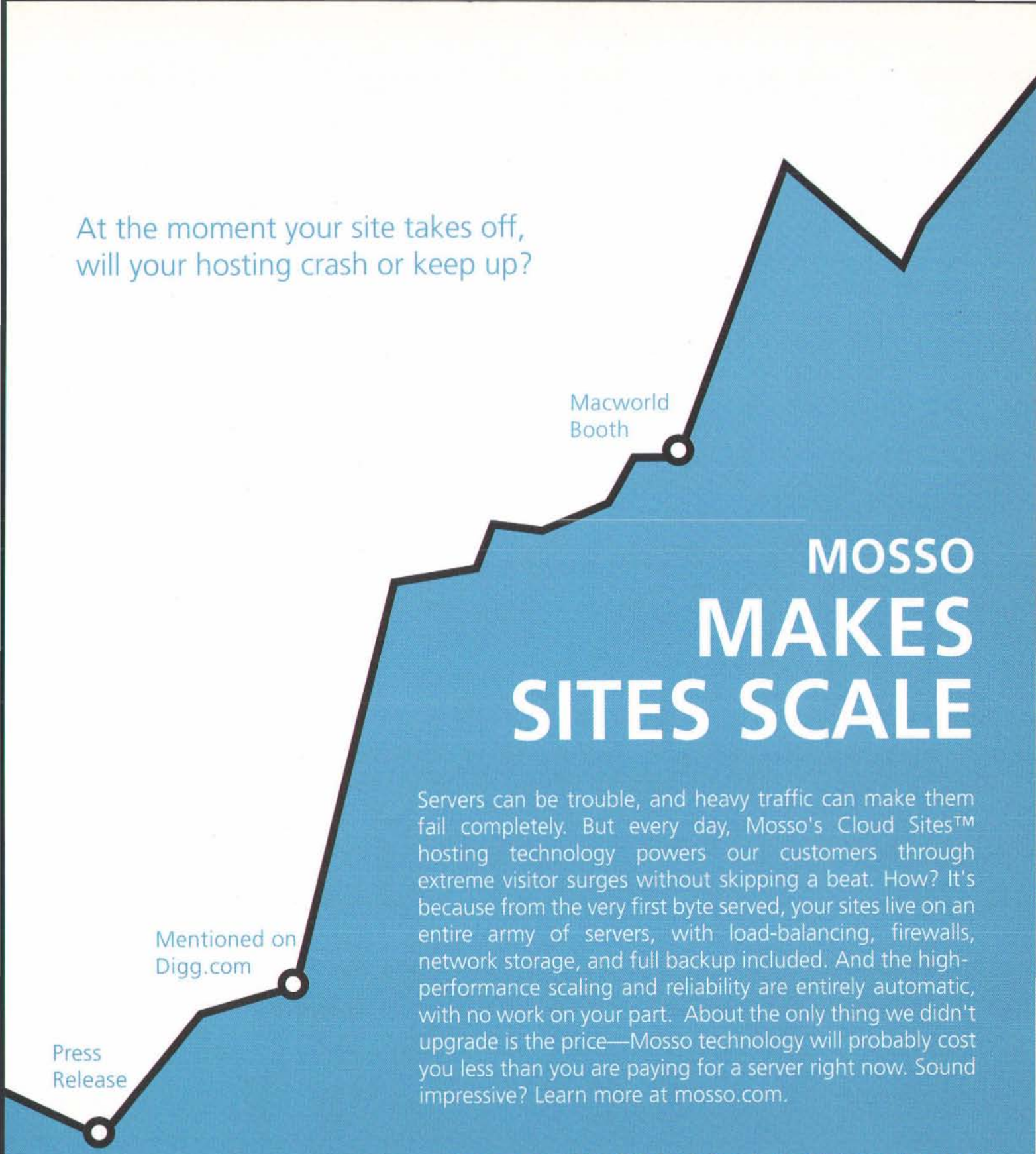


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# Macintosh Data Encryption

## Protecting data at rest through disk encryption

by Rich Trouton

## Introduction

One of the hot new items in recent years, in both government and corporate IT, has been laptop encryption. In large part, this is a technical solution to a human problem: data theft, loss or exposure. People lose laptops, thieves steal laptops because they're valuable, the kids find information that they're not supposed to on Mom's or Dad's computer and tell all their friends about it, and so on. Does everyone need encryption? Maybe not. My own personal yardstick is "Is there anything on this machine where I would have a problem with it being posted on the web, or tacked up on a public bulletin board?" If your own answer is "No", you probably don't need to encrypt anything. If your answer is "Yes", then you probably should.

## How best to protect your data?

There are two main encryption strategies that are in use today on the Mac. The first is file and folder encryption and the second is whole disk encryption (WDE). Both have their pluses and minuses, especially with regards to data recovery. After all, encryption boils down to "scrambling your data so that other people can't read it." Normally, you try to make sure that all your data is intact; encryption strives to deliberately scramble what is saved to the hard drive. The trick with encrypting your data is that you want to scramble it in such a way that authorized people can unscramble it while no one else can.

File and folder encryption works pretty much like it sounds. It allows you to encrypt and decrypt selected files or folders. Tools that use this method make you choose what you want to encrypt and don't encrypt anything that's not selected for encryption. By and large, this is the method of data protection that Apple has chosen to support, and Apple has provided some great tools with Mac OS X for file and folder encryption. Another third-party encryption tool available for Mac OS X that uses file and folder encryption is TrueCrypt, which is an open-source project that supports Windows Vista/XP, Mac OS X, and Linux.

Whole disk encryption is also fairly self-descriptive. It encrypts an entire hard drive and everything on it. In this model, everything on that hard disk is encrypted and the only way to have it not be encrypted is to move it off of that drive. Because of this, WDE is the preferred encryption method for most corporate and government environments. Using this encryption strategy has been problematic for the Mac until fairly recently. In fact, until May 2008, there wasn't a whole disk encryption software solution available for the Mac that supported an encrypted boot drive. There are now a couple of software packages that support Intel-based Macs, but PowerPC-based Macs still don't have a WDE software package that allows you to boot from the encrypted drive. On the whole disk encryption side, the two main software packages available for the Intel Macs are PGP's Whole Disk Encryption and Checkpoint's Full Disk Encryption.

## Mac OS X's built-in encryption solutions

As mentioned earlier, Apple has chosen to support the file and folder encryption method with its encryption tools. The main tools are encrypted disk images and FileVault in Mac OS X 10.3.x and higher.

Encrypted disk images are just like any other disk image you can create with Disk Utility, with the exception that they are password protected and that password is used to encrypt the disk image with AES-128 128 bit encryption when the disk image is first created. You can use them like any other disk image file. It may be copied to, or created on, network volumes or removable media including Zip drives, USB flash media or FireWire hard drives. A particularly nifty feature of encrypted disk images is that when mounting the disk image from a remote server, is that all disk image-related communication between the computer mounting the disk image and the server is protected with the same 128 bit encryption used to create the disk image.

FileVault takes the same encrypted disk image technology that Apple created for encrypted disk images and uses it to protect one particular folder: your account's home folder. How FileVault does this is by creating an encrypted disk image that's able to grow or shrink with the amount of data stored in your home folder, mounting that encrypted disk image when you log in and then un-mounting it when you log out. The user's home

is encrypted using the same AES encryption that is available for encrypted disk images and the contents of the home folder are automatically encrypted and decrypted on the fly.

FileVault has some upsides and downsides. The biggest upsides are cost and ease of use. It's built-into Mac OS X (v 10.4 and higher), so you're getting it for the same price that you paid for OS X. Apple has also gone to a considerable amount of trouble to make sure that you hardly notice anything different about working from an account that's not encrypted from one that is encrypted. One other attractive feature of it is that, because only the home folder for a particular account is being encrypted, you're able to support the rest of the Mac like you always have without having to deal with the extra complications that encrypting the OS and your applications may bring.

**"Is there anything on this machine where I would have a problem with it being posted on the web, or tacked up on a public bulletin board?"**

The biggest downsides have to do with backups and with using network accounts where the password is managed from a server, instead of from your own Mac. In most cases, these accounts are being provided by an external directory service (like Apple's Open Directory or Microsoft's Active Directory).

With regards to backups, the problem is that FileVault, at its heart, uses a password-protected encrypted disk image. The backup software will not be able to unlock the disk image while you're logged out of your account and only backup the files you changed since the last backup operation, so it will try to copy the entire file. Worse yet, if you change the encrypted disk image while it's being backed up (for example, by logging in to the account) you can corrupt the backup, making it hard or impossible to restore your files if needed. That's one of the reasons why Time Machine on 10.5 only backs up a FileVault-encrypted home when the user logs out. The best solution I've found so far is to use Time Machine with an attached disk drive and log out of my account on a daily basis, but that may not be workable for everyone.

The problem with network accounts from an external directory service combined with FileVault is again that FileVault is using a password-protected disk image. The disk image only knows the password that's able to unlock it and doesn't check with any other sources, like the external directory service that actually manages your password. So it doesn't know that you forgot your password and had to call your company or school's help desk to get it reset, and it doesn't pick up the new password when IT resets your account's password on their end. All it knows is that the password that you put in to the login screen doesn't match the one that it needs to unlock the disk image. Fortunately, Apple has provided a way to reset the encrypted


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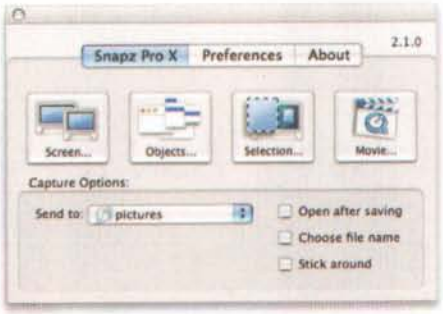


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disk image's password via the FileVault Master Password, but this is a solution primarily built for dealing with OS X's own local accounts instead of network accounts. Leveraging the Master Password to help you recover network accounts that have FileVaulted local homes usually requires some work on the command line. The best solution here is both user education and IT training. The user education is training your users that they need to change their account's password from their FileVault-encrypted Mac. The IT training is in the various methods of recovering a FileVault-encrypted account's data and is for when your users forget their training, or just forget their password.

## Third-party encryption solutions

There are a number of encryption solutions available from sources other than Apple. I'll only be covering the ones I'm most familiar with: TrueCrypt, PGP's Whole Disk Encryption and Checkpoint's Full Disk Encryption.

TrueCrypt on OS X offers both file and folder encryption and whole disk encryption for non-boot disks, but does not currently have all of the abilities that it does in its Windows version (which include whole disk encryption of boot disks, as well as offering the ability to create and run your PC from a hidden encrypted operating system). TrueCrypt is also free and offers the best cross-platform compatibility of the encryption systems I've looked at, as it supports Windows, Mac OS X and Linux. If you need to work cross-platform and keep your encryption solution the same, TrueCrypt is a pretty good solution.

From an enterprise IT standpoint, TrueCrypt has the disadvantage of not having a back door. If you don't have the password, you don't get in. Period.

You can download TrueCrypt from the TrueCrypt website at http://www.truecrypt.org/.

PGP's Whole Disk Encryption for Mac OS X offers file and folder encryption and whole disk encryption, though it only supports WDE for boot disks on Intel Macs. (On Power PC Macs, PGP still supports whole disk encryption, but you can't boot from any of the encrypted drives). PGP is very good at providing data scrambling and unscrambling without interfering with the user, which is pretty much what you want from an encryption product. You can even use your Mac normally while the initial encryption is running, as PGP is smart enough to know what disk sectors are already encrypted and which ones are not, allowing the system to work normally during the whole process. You will probably notice a very high loss of performance during the initial encryption process because the hard drive will be in really heavy usage (after all, PGP has to read and rewrite the entire disk surface).

From an enterprise IT standpoint, PGP has another advantage in that the company also provides server-based management tools to manage the encryption policies of your PGP-encrypted machines. Don't want your users to be able to turn off their encryption? PGP's management tools can provide


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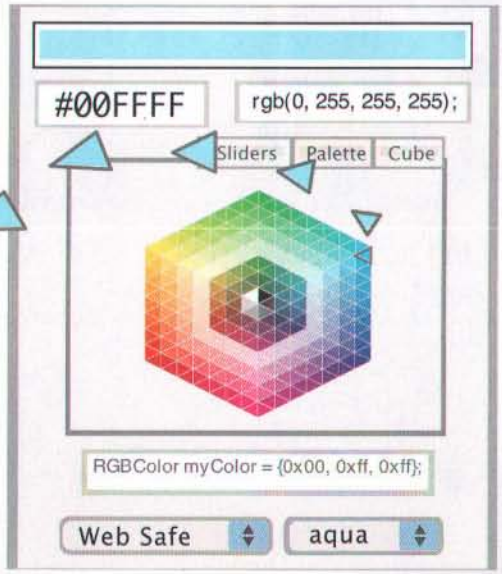


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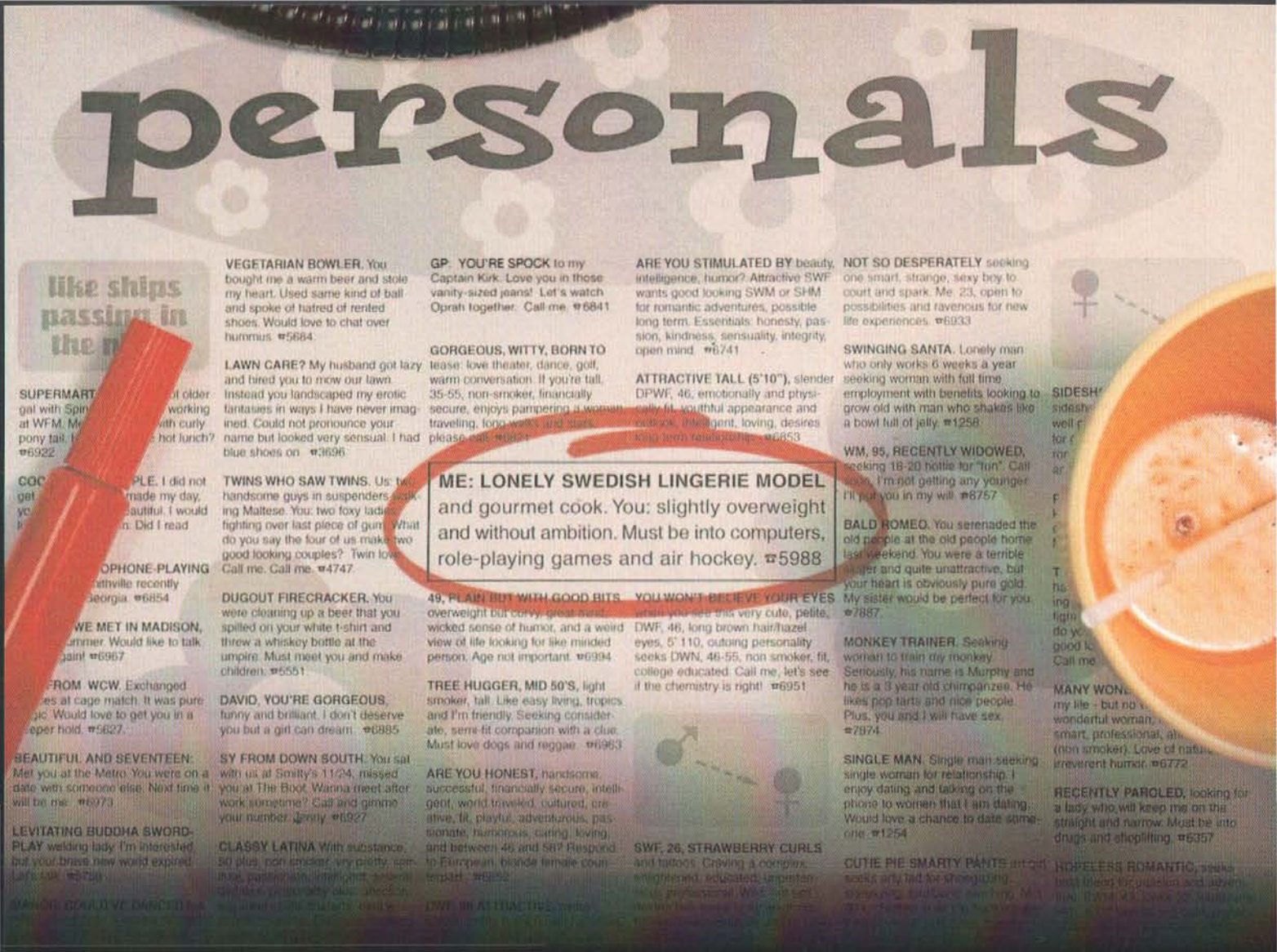



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The main downside to PGP is that Boot Camp does not currently work in combination with an PGP-encrypted boot drive. If you need to run Windows on your PGP-encrypted Mac, I suggest using software like Paralllels or VMWare.

You can download an evaluation copy of PGP from the PGP website at http://www.pgp.com/downloads/desktoptrial/index.html

Checkpoint's Full Disk Encryption for Mac OS X is similar to PGP's overall design when it comes to whole disk encryption for Macs, though Checkpoint's solution is for the Intel Macs only and does not support Power PC Macs. Like PGP, Checkpoint's encryption is pretty good at scrambling and unscrambling your data in a transparent fashion, and also allows the Mac to be used normally during the encryption process.

Where Checkpoint fell short in my testing has been in the area of enterprise IT management, with the biggest problem being the issue of recovery keys. Unlike PGP, which offers the option of having the recovery key be generated and managed by a management server, Checkpoint's recovery key is generated by the Checkpoint software on the Mac itself. The problem then is that the recovery key then needs to be copied off of the computer and stored somewhere else. The Checkpoint-generated recovery key also periodically updates (usually, this is triggered by the Mac changing its hostname or some other similar global variable) so you need to also make sure that the copy of the recovery key you have is the latest one or you may not be able to use the key to recover your encrypted data.

For more information about Checkpoint's Full Disk Encryption for Mac OS X, you can go to http://www.checkpoint.com/products/datasecurity/pc/index.html

## Protect your encrypted data – Back up

Protecting your data with encryption is a great way to guard it, but does require you to remember yet another crucial password, and losing the key is like losing the combination to an unbreakable safe. What's the best way to protect your data against this? Backups, backups, backups. Make a regular backup of your encrypted data to somewhere you know is safe. As mentioned earlier, Time Machine can back up your FileVault-encrypted home folder when you log out and you can use other backup tools to back up your data once you've unlocked the encryption and logged in to your account. One consideration to keep in mind is that there's usually no point in encrypting the files on your Mac if you've got an un-encrypted copy of your files in a place where the backups can be compromised easily.

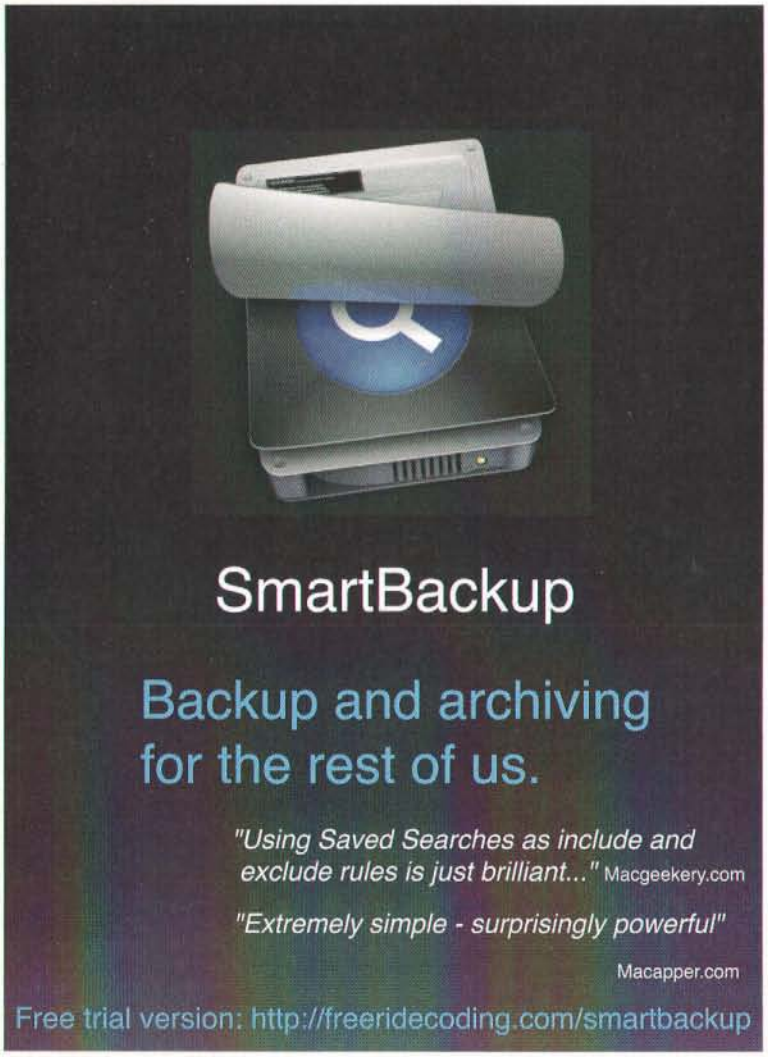
## Conclusion

Encryption is an important method of protecting your data. As we've seen, most methods can be transparent to the user. Depending on your needs, the Macintosh platform offers several different styles of encryption. From the built-in, disk-imaged-based home-directory-only FileVault to several vendors offering driver-level full disk encryption, you can choose how bullet-proof you need the protection to be.


### About The Author

***Rich Trouton is a Macintosh sysadmin with over ten years of experience, both in the enterprise space and in the small business space. He lives in Maryland and is currently providing Macintosh support for an unnamed government agency.***





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by Edward Marczak

# Python: Getting OOPy with it

## Or, delving into the real Object-Oriented Programming Features of Python

## Introduction

The last several articles have been focusing on Python basics: data types, flow control, modules and more. Plus, the first "Learn Python on the Mac" article pointed out some Mac-specific tweaks needed to enable the built-in help docs. Here, we go a little deeper and talk about creating classes, Python's real Object Oriented Programming (OOP) powerhouse. This article will start to introduce OOP in general, and next month's column will get into Python specifics. Without further delay, let's begin.

## Why OOP?

Why OOP, indeed? I went back and forth for some time deciding if this was the right time to introduce the topic. There are plenty of other subjects relating to Python that I still haven't addressed. One can write perfectly competent, purely procedural Python programs without ever touching OOP directly. However, understanding OOP and having the class mechanism at your disposal is incredibly powerful. Also, if you ever want to get into GUI applications using Python as the language underneath, the ability to write classes is essential. Finally, those 'other topics' that I mentioned will come along in later articles, so, it will be good to get OOP into your brain sooner rather than later.

Essentially, classes are just another namespace packaging mechanism in Python. Typically, they provide a generic model of a real-world object. Classes promote reusability, and can cut development time. If you're coming to Python from C++ or Java, you're in for a surprise: classes in Python do away with some of the pomp and circumstance found in those languages. Like most things in Python, they're straightforward and easy to understand.

## Objects

I've talked a lot about objects in Python in previous article, but we haven't really defined what that means. In one sense, you're using objects in Python if you know it or not. Python generically treats *everything* as an internal object. For example, when you make the assignment 'x = 'hello', x "*is a*" string object. On a more pedantic level, though, objects mean several things.

### Model Factory

When you define a class, the class itself doesn't really do much. It acts as a model for instantiated objects. It's a factory that can churn out objects based on the namespace it contains.

### Inheritance

Classes can inherit methods and objects from other classes.

### Extending and Overloading

Related to inheritance, objects can then extended an inherited class by adding new attributes and methods, or, override an attribute or method of the class it inherits from. Extending adds new behavior to the class. Overriding—also called *overloading*—changes the behavior of the method or class.

It all comes down to the dot operator, which we've been using all along to access module attributes and to call object methods (like a string method to strip whitespace). We've also talked a bit about namespaces. The subtlety behind the dot notation is that it forces python to perform an upward search, through the inheritance tree of namespaces. How does this work?

Last month, we talked about modules, and we can use that initially to illustrate. Take the following example:

```
#!/usr/bin/env python

x = 5
y = 7

def ModuleA():
  x = 12
  print 'In ModuleA'
  print x
  print y

print 'Main'
print x
```

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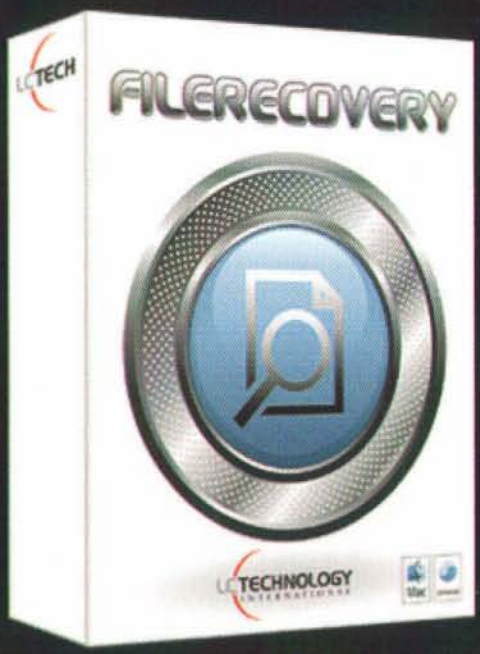


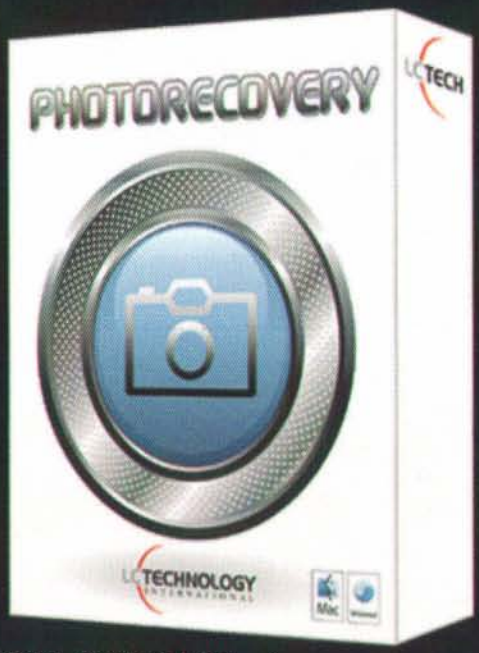


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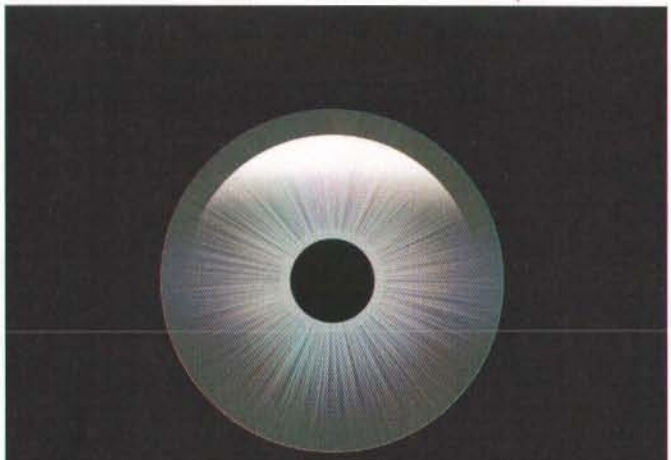

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```
ModuleA()
```

As you may expect, running this short program gives the following output:

```
Main
5
In ModuleA
12
7
```

Obvious? Perhaps. The main routine is asked to print x, finds x in its own namespace and does so. Then, we call ModuleA(), which first sets x, and is then asked to print x. Well, at this point, there are *two* x variables. So, the print statement in ModuleA() starts a search—from the bottom up—to locate x. It first looks in its own namespace, and finds x. Its own version of x, that is, and prints it. ModuleA() is then asked to print y. It again starts a search. Since it doesn't find y in its own namespace, it looks in the namespace directly above it. It finds y there and stops the search.

Note that in the above paragraph, it all comes back to namespaces. In fact, this search-though-the-namespace is initiated any time we use the dot operator in the *object.attribute* form.

## It's all about the dot

As mentioned above, a class is just another Python mechanism of packaging up a namespace. Here's a simple Python class:

```
class ClassA():
  a = 5
  b = 7
```

Now, a slightly dirty secret is that a class really is just a namespace package, and we don't even have to instantiate it:

```
print ClassA.a
```

will do what you expect and print "5". You can even make further assignments:

```
ClassA.c = 9
print ClassA.c
```

Treating a class as a generic, function-like namespace sells the class mechanism a little short, though. Classes have the power to inherit attributes from other classes. Let's define another class:

```
class ClassB(ClassA):
  b = 44
  c = 88
```

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In this case, ClassB *inherits* from ClassA. Essentially, all of the attributes from ClassA are copied into ClassB on creation. Let's instantiate three objects to illustrate:

```
inst_a = ClassA()
inst_b = ClassB()
inst_c = ClassA()
```

Note that both inst_a and inst_c are instances of ClassA. Each object has a variable a in its namespace:

```
print inst_a.a
print inst_b.a
print inst_c.a

5
5
5
```

When inst_b is instantiated, ClassB inherits from ClassA. This is why ClassB has an 'a' variable in its namespace. Figure 1 shows this graphically.

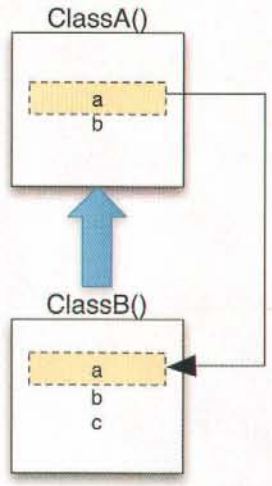


**Figure 1: Class inheritance**

When ClassB() is asked about variable 'a', it first searches its namespace. Not finding it, the search continues in the class it inherited from—also called its *superclass*—and the variable is found. We can alter these variables in our instance simply:

```
inst_b.a = 99
print inst_b.a
```

This will print 99, as you'd expect. However, it is only changed in the instance, not up the chain:

```
print ClassB.a
```

...prints '5'.

## Conclusion

Creating an elegant object oriented program takes some planning. That may be one of the key differences between a straight procedural based program, and an OOP-based one. OOP lets you be a bit more strategic. It also lets you build a larger app based on smaller, reusable objects. Next month, we'll dig into details and implementation a bit more.

Media of the month: "No Line On The Horizon" by U2. Now, this may be an obvious choice, a safe choice, or a polarizing choice. U2 has become pretty palatable to a broad audience these days. If you're one of those people that never gave them a shot, this is actually a decent album to start with.

### About The Author

***Ed Marczak is the Executive Editor of MacTech Magazine. He lives in New York with his wife, two daughters and various pets. He has been involved with technology since Atari sucked him in, and has followed Apple since the Apple I days. He spends his days on the Mac team at Google, and free time with his family and/or playing music. Ed is the author of the Apple Training Series book, "Advanced System Administration v10.5," and has written for MacTech since 2004.***


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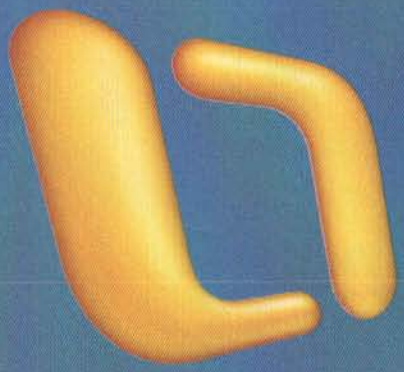


# Exchange Web Services

## "Finally, we can all get along," or, "What administrators need to know about Microsoft's newest E-mail protocol"

*by William Smith*

## Cloud collaboration

"Collaboration" is the current buzzword in the Enterprise and three big players—Apple, Google and Microsoft—are all targeting the Cloud as their arena for releasing new services. Up in the corporate cloud lies Microsoft Exchange, a mature and robust set of technologies for bridging the sync gap between different applications, different devices and more importantly different platforms.

Exchange Server is Microsoft's product for serving E-mail, calendars, contacts and more. It is nearly ubiquitous in the Windows-dominated enterprise and has a strong foothold in the higher education market as well. Exchange acts as a hub with a variety of local, mobile and external clients using both standard and proprietary protocols. However, with the recent European Commission's decision requiring Microsoft "to disclose complete and accurate specifications" for its server communications protocols, third party companies now have the opportunity to expand and develop products that will work with Exchange.

Exchange Web Services (EWS) is the first of a few new Microsoft server technologies that will play a key role in both Apple's plans to penetrate the enterprise and Microsoft's plans to expand compatibility with Macs. While Google hasn't announced any plans for integrating its mail system with Exchange, it too may very well decide to capitalize on EWS in the future. It has already taken steps toward using one Exchange technology, ActiveSync.

## Entourage

### What happened to Outlook for Mac?

In addition to mail, Exchange allows users to maintain and share calendar events, contacts, tasks and notes. Each of these objects can be sent and received via e-mail allowing groups within companies to set up their own workflows. Combined with a feature-rich client that can process these incoming items, such as Outlook for Windows, Exchange becomes the hub for relaying thousands of pieces of information daily for both small businesses and large institutions.

Isn't Entourage an Exchange client and can't it do all this too? The fairest answer to that question is "It's getting there." Entourage is akin to Outlook for Windows and is sold as part of the Office for Mac suite of applications that includes Excel, PowerPoint and Word. It is the closest to a feature-rich client available for the Mac but still lacks all the capabilities of Outlook when used with Exchange.

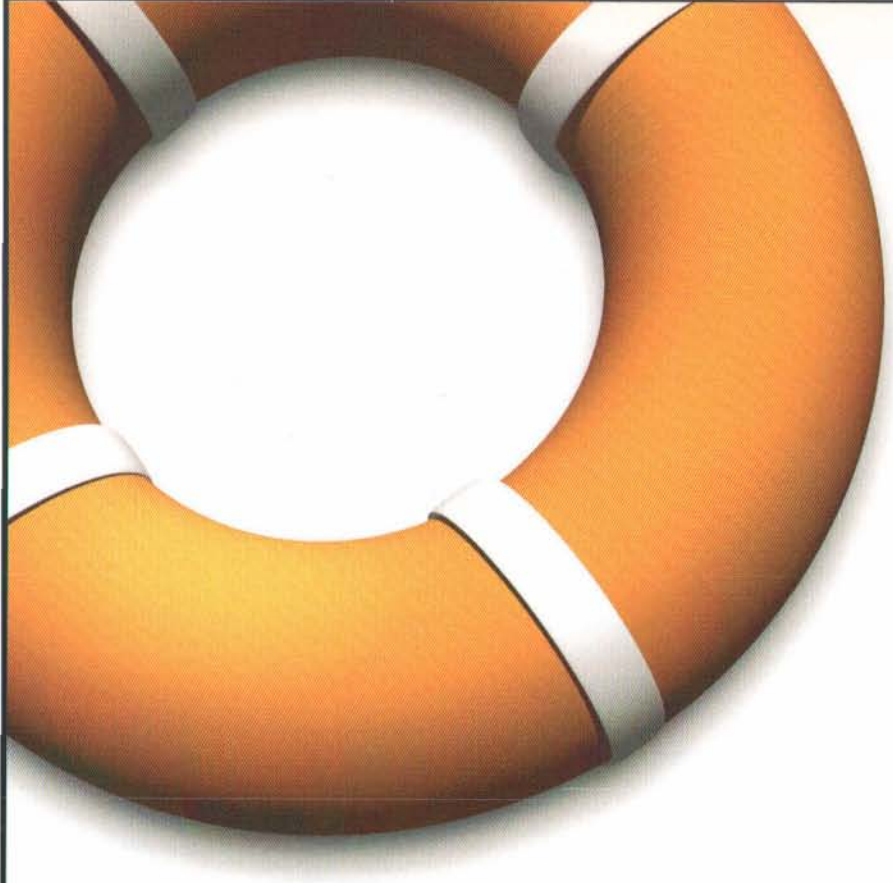
Outlook for Mac, never to be confused with Outlook Express, was actually developed by the Exchange Server Team at Microsoft a little more than 10 years ago but was discontinued after Outlook 2001. Outlook for Mac was a client that used the Messaging Application Programming Interface (MAPI) connection just like Outlook for Windows. MAPI is just mail protocol like the more common POP or IMAP protocols used in businesses and at home today, but what's important about MAPI is that Microsoft never licensed it. MAPI is an old and loosely designed protocol that Microsoft kept proprietary. While Outlook for Mac was still never equal in features with Outlook for Windows, it did communicate with Exchange Server the same way. Entourage had never done this until version 13.0.0, also known as Entourage for Exchange Web Services (EWS). More on that in a bit.

## A tale of two protocols

### MAPI or WebDAV?

The MacBU has probably some of the toughest decisions to make about software development. Their mission is to provide interoperability with their Office for Windows counterpart while maintaining the look and feel of a Mac OS application. That's not easy to do. When the Exchange Server Team decided for various reasons to discontinue Outlook for Mac, the MacBU decided to pick up and add Exchange support to Entourage, their existing E-mail product. They did this instead of continuing Outlook for Mac. After all, why develop and support two E-mail applications that do mostly the same thing?

One of the more controversial decisions was to shy away from MAPI and adopt WebDAV, which is an HTTP-based protocol for sharing information. At the beginning of this decade WebDAV was



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thought to be the future. It was an open standard, which also meant not proprietary to Microsoft, and was growing in popularity. Apple was also using WebDAV in a new product that it had released: iTools and .Mac, later to become mac.com and then MobileMe. They offered access to a personal iDisk that could be reached from anywhere on the Internet via WebDAV.

WebDAV in Entourage, however, was not robust enough to deliver everything that Outlook using MAPI could deliver. Tasks didn't sync, public folder support was very limited and connectivity was slow. Outlook Web Access (OWA), which is a web-based version of Exchange Server, came in two flavors: a full version that could be accessed only via Internet Explorer for Windows using ActiveX controls and a light version for everyone else. Since Entourage was not Internet Explorer and not ActiveX-enabled it fell into the "everyone else" category. It faced the same issues as the light version of OWA and to this day many of the limitations of OWA are the same as those for Entourage.

## Why didn't MacBU just use MAPI?

The original business decision by the MacBU to use WebDAV was thought to be a step forward. However, it may have been two steps back. The Exchange Server Team at Microsoft never adopted WebDAV as a major protocol of the future and MAPI continued to be the ongoing protocol of choice for Exchange Server and Outlook for Windows.

The first major release of Entourage with Exchange Support was Entourage 2004. (Entourage X, which was the first Mac OS X mail client from the MacBU, had very limited Exchange support through a later-released 10.1.4 update but relied on IMAP for connectivity rather than WebDAV.) Entourage 2004 was the first Mac OS X E-mail client that could truly be called an Exchange client. Through WebDAV it could access mail, calendars, contacts and public folders. However, the first release of Entourage 2004 lacked a lot of parity with its Outlook for Windows counterpart. This was mainly due to constraints in development time.

Outlook was not built in a day and likewise Entourage had to grow in its Exchange support. Entourage 2004 saw major improvements in Service Pack 2 (SP2), which introduced lots of complex features such as multiple calendars and address books, browsing the Global Address List (GAL), delegation support and support for sharing mail folders, calendars and address books. Essentially, everything that the MacBU wanted to put into Entourage 2004 from the beginning but didn't have time to include, got released as a major update a little more than one year later.

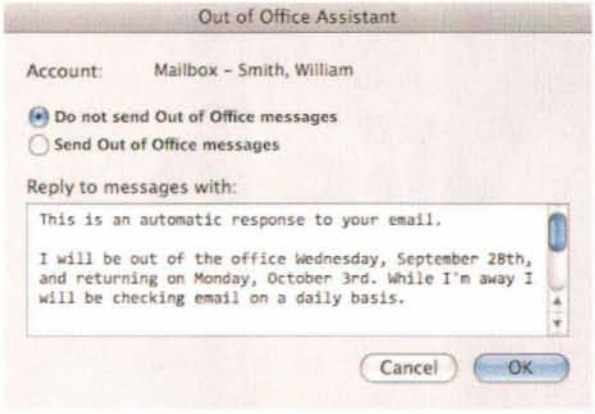
Unfortunately, Entourage still couldn't do everything that Outlook for Windows could do, even with these major enhancements. This was due partly to the amount of time needed to develop Exchange Server support within Entourage and the limitations of WebDAV. Entourage was still a second-class citizen and its users were demanding parity with Outlook for Windows.

## Sneak peek at EWS

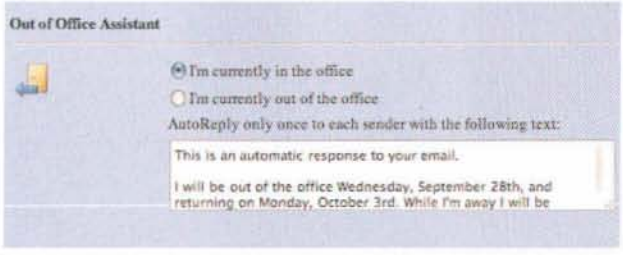
Fast-forward a few years to 2008. The MacBU released Office 2008 with an upgraded version of Entourage at the Macworld Expo in January. Three years had passed after another major version of Office: v2004. However, Entourage 2008 was underwhelming for Exchange users. MacBU had released four major versions of Entourage, including SP2, with nearly 100 Exchange-specific features but parity with Outlook for Windows still seemed far away.

What was happening behind the scenes at MacBU, however, had been methodically planned and plotted to try to take that step forward again and maybe even regain the two steps lost using WebDAV. Entourage 2008 introduced a few new features such as the Out of Office Assistant and AutoDiscover. These features themselves didn't greatly advance feature parity with Outlook for Windows but the technology behind them, EWS, did.

Exchange Web Services is a feature found only in Exchange Server 2007; it is not present in Exchange Server 2003 and earlier. To illustrate this, the Out of Office Assistant in Entourage will still work with Exchange Server 2003 much like the Out of Office Assistant found in the light version of OWA. But when Entourage 2008 connects to Exchange Server 2007 it begins to take advantage of EWS. Remember, Entourage can do mostly what OWA can do because of WebDAV. With EWS, though, it can do more. Users connecting to Exchange Server 2003 will see a basic Out of Office Assistant in Entourage,




which is similar to the Out of Office Assistant found in OWA.




However, Entourage users connecting to Exchange Server 2007 will see an extended version of the Out of Office Assistant. It includes options for sending replies internal to the company as well as external to the company and the ability to specify start and end dates for the responses:

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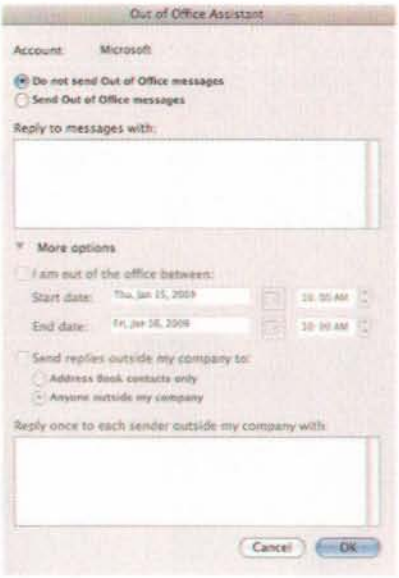


## Nails in coffins

What happens now to those two protocols: MAPI for Outlook and WebDAV for Entourage? Effective with Exchange Server 2007 both MAPI and WebDAV were "de-emphasized". That doesn't mean Exchange client features are going away but rather newer technologies are assuming the responsibilities of those features. It does mean, though, that at some point in the future, maybe not necessarily the next version, MAPI and WebDAV will be gone from Exchange Server. It also means that further development to expand these technologies has ceased.

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The Microsoft TechNet document "Discontinued Features and De-Emphasized Functionality in Exchange 2007 RTM" (aa998911) explains that both MAPI and WebDAV along with other technologies are now considered "legacy Exchange features". In another TechNet document "Exchange 2007 Development" (bb124516), Microsoft specifically states for WebDAV, "We recommend that you develop new messaging applications using Exchange Web Services, and migrate existing applications when feasible." Both articles are available at http://technet.microsoft.com.

## Bye-bye, public folders

On a side note, public folders have also been de-emphasized in favor of SharePoint and the Exchange Availability service. Exchange Server 2007 threw several administrators for a loop when it was released because although the public folders service was still available it wasn't enabled by default. MacBU announced at Macworld 2009 the Document Collaboration Companion (DCC), which went into private beta in February and will be released later this year.

The DCC is a stand-alone application for Mac OS X that provides better uploading, downloading and check-in/out from SharePoint servers as well as Office Live Workspaces. More information is available at Microsoft's Mactopia IT Pros website http://www.microsoft.com/mac/itpros/dcc.mspx.

# One protocol to bind them all

## Building bridges

Office 2008 took the MacBU nearly fours years to ship, which is a very long development cycle for any software. Why did it take this long? To say this was all because of Entourage would be an exaggeration. MacBU was also dealing with making Office 2008 compatible with Office 2007 for Windows. This meant porting over features such as the new XML file format, new core animation code and adapting the Ribbon interface from Office 2007 to the Elements Gallery in Office 2008 to maintain the Mac "feel". None of this affected Entourage but the Entourage developers themselves were busy building bridges. *[Ed. Note: In a conversation with Microsoft, I was reminded that this transition was also hampered by the conversion to Intel and a new version of Xcode.]*

Before 2005, the relationship between the MacBU and the Exchange Server Team at Microsoft was practically non-existent. The business units didn't meet and the Exchange Server Team didn't pay much attention to bug reports from the MacBU. Again, fast-forward to 2008. By that time the Exchange Server Team was not only meeting with the Entourage developers twice a week but they themselves were also involved with testing Entourage. This new relationship led to close collaboration on items such as the Office 2008 for Mac Administrator's Guide (http://www.microsoft.com/mac/itpros/default.mspx) and even EWS itself.

That's important to restate, highlight and underscore: MacBU was involved with the development and testing of Exchange Web Services in Exchange Server 2007.

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### Entourage EWS beta

MacBU announced a new product this year at Macworld 2009 or rather a major update to Entourage 2008: Entourage for Exchange Web Services. They even consider this an upgrade rather than an update. The version number, which can be found by selecting About Entourage from the Entourage menu, says 13.0.0. The prior version was 12.1.5. According to their IT Pros website, "Entourage for Exchange Web Services has been completely redesigned for Microsoft Exchange Server 2007 Service Pack 1 with Update Rollup 4 or later."

Only a handful of new features were introduced with Entourage EWS, which is currently in public beta, but some of them were long-standing requests. Specifically, Categories, Notes and Tasks now sync to Exchange Server. Additionally, the MacBU was able to add support for attachments in Calendar events and GAL searches when connected to Exchange using an OWA address. The interface itself is exactly the same as Entourage 12.1.5. They have effectively replaced the engine in the car leaving the body alone.

The Entourage EWS beta is open to the public but does require that participants affirm they indeed meet the minimum server requirements. The beta cannot be installed alongside Entourage 2008 (12.1.5), which means the user's computer must be dedicated to testing Entourage EWS. The beta is not intended for anyone who cannot support himself and restore from backups should something go wrong. For more information visit http://www.microsoft.com/mac/itpros/entourage-ews.mspx.

### Outlook for EWS

Will Outlook for Windows follow suit? More than likely. It too is already using Exchange Web Services for AutoDiscover and the extended Out of Office Assistant when connecting to Exchange Server 2007.

If Outlook switches to EWS then the ramifications are apparent. Both Entourage and Outlook will once again be connecting to Exchange using the same protocol, just like they did 10 years ago, and that means Exchange client feature parity between the products is possible.

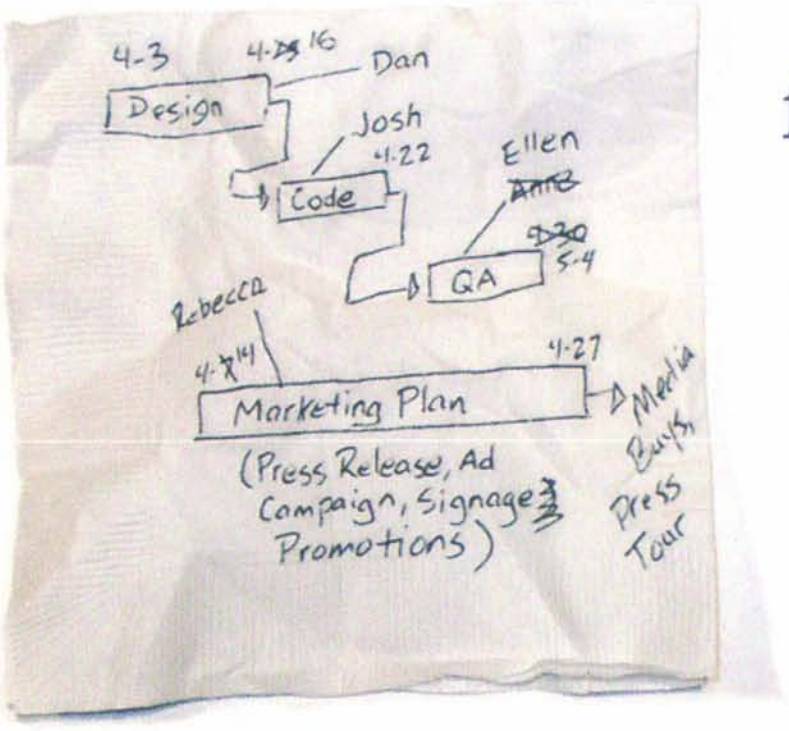
That's another important point to restate, highlight and underscore: If Outlook for Windows and Entourage for Mac OS X both connect to Exchange Server using the same protocol then complete Exchange client feature parity is once again possible.

## Characteristics of EWS

### HTTP

Exchange Web Services offers "anywhere access". That means any client sitting on a company intranet, connecting from the Internet or connecting via a wireless device can take advantage of EWS.

Many of today's applications use Remote Procedure Calls (RPCs) to work with other applications. Basically, that means one application tells another application running on another machine to do something. For example, Outlook for Windows may send an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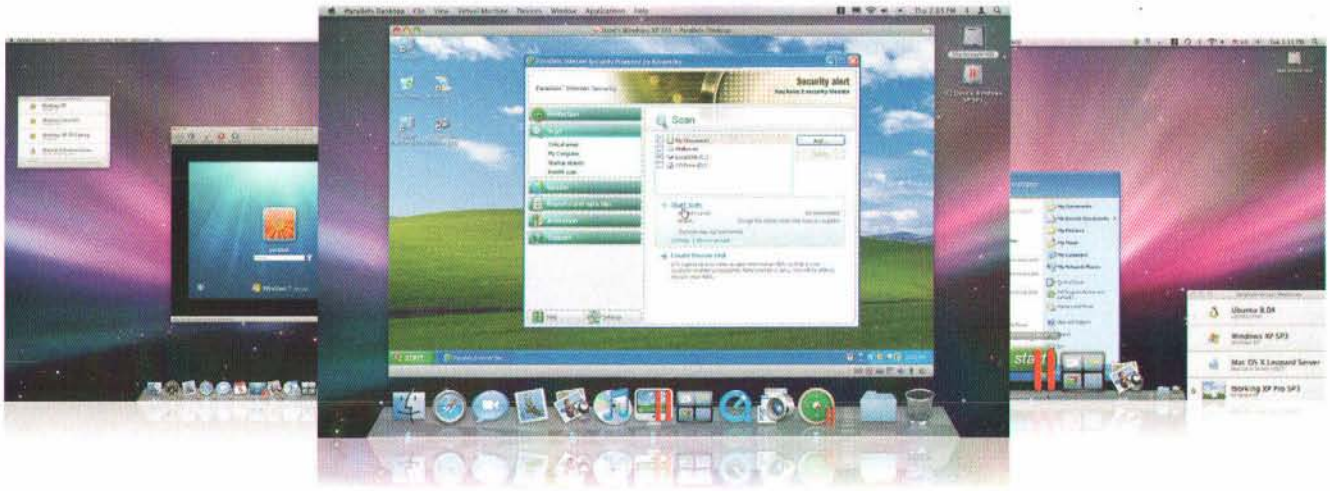

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RPC call to an Exchange Server to set the Out of Office message for a user's account. The downside to using RPCs is that they are often blocked by firewalls. They're certainly not used for communications by computers over the Internet to access servers on a private company network. HTTP, on the other hand, is accessible most anywhere.

EWS sits on top of Microsoft's Internet Information Services (IIS), which uses HTTP. While this may sound like WebDAV, EWS is actually a cousin protocol sitting alongside ActiveSync for mobile devices, OWA for webmail and Unified Messaging for telephony systems. EWS replaces not only WebDAV but also other programming interfaces such as CDOEX. CDOEX, was necessary for complex calendaring, which Entourage connected to Exchange Server 2003 could never do.

### XML

EWS uses the Extensible Markup Language (XML) to provide the standard message format for the exchange of information between Exchange Server and the mail client. XML is an established framework for creating a custom language. In this case the custom language is the Exchange Server language. The beauty of XML is that it can be used to share information between different computer platforms and applications without having to pass through interpreters.

Unlike the proprietary MAPI protocol, XML is also an open standard and is becoming more and more prevalent in the Microsoft world. Office 2007 for Windows and Office 2008 for Mac both now ship with the new XML file formats that are flat and more easily exchanged cross-platform. XML can be used in other ways too such as E-mail storage, preference lists and general data storage for access by multiple applications.

### Wrapped in SOAP

Simple Object Access Protocol (SOAP) is a protocol that's also constructed using XML but intended for sending communications over HTTP. During an EWS session the client will take its XML instructions and wrap them in a SOAP envelope. This entire bundle is then transmitted over HTTP to the server.

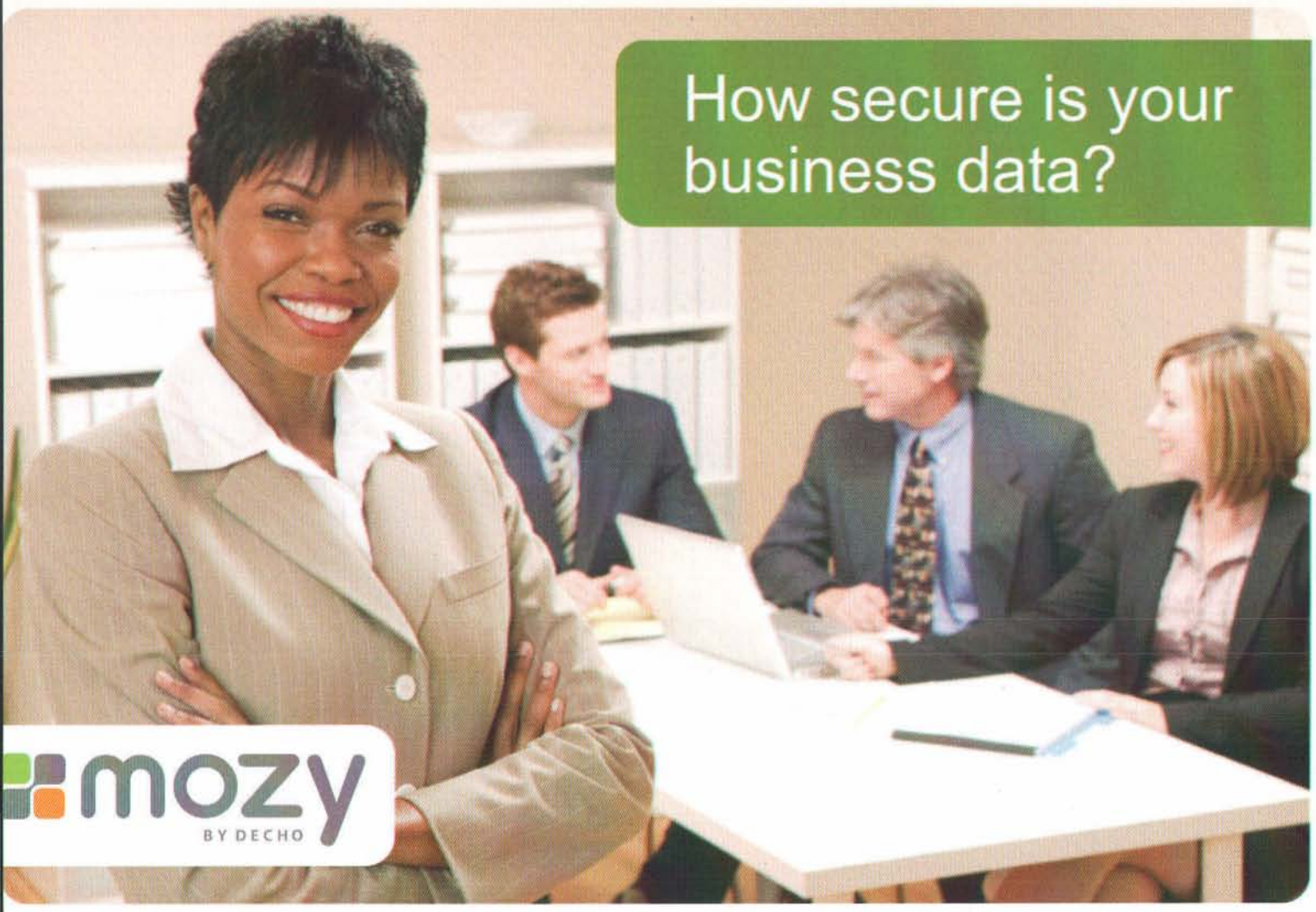
This approach to communicating with Exchange Server translates to increased speed as well as increased accessibility. Whereas Entourage 2008 (12.1.5) takes six instructions to execute a command over WebDAV, Entourage EWS takes just one. See below.

Restate, highlight and underscore: Entourage EWS is faster than Entourage with WebDAV.

## Snow Leopard

### Signs point to "Yes"

Apple announced last June that Mac OS X 10.6 (Snow Leopard) would include Exchange support out-of-the-box for Microsoft Exchange 2007. Will it connect using Exchange Web Services? Signs point to "Yes", but Apple has made no public comment about this.

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Because they specify "Microsoft Exchange 2007" and not just "Microsoft Exchange", that almost certainly means they're excluding "Microsoft Exchange 2003", which is still prevalent in many organizations. And, remember, that MAPI and WebDAV are de-emphasized protocols with direction from the Microsoft Exchange Team to develop new applications that work with EWS. While POP and IMAP are still valid and available mail protocols in Exchange they cannot handle the extended set of features such as calendaring and contacts. If Apple were developing using WebDAV or MAPI then they would most certainly be making a huge mistake at this point in time.

### Planning for Snow Leopard

Organizations planning to adopt Snow Leopard's Exchange support, assuming Apple is indeed going to use EWS, need to first ensure that they are onboard with Exchange Server 2007. They should also define their requirements for Exchange usage too. While Apple has a history of making great products that work very well, they don't necessarily have a history of offering a wide array of features in first releases.

Snow Leopard will most likely support syncing E-mail, Calendar, Contacts, Tasks and Notes the day it ships, but Apple may decide that some things like public folders are not worth supporting since that feature has been de-emphasized. Complex features such as delegation and shared folders may be slated for a later release or not at all and features currently specific to Outlook for Windows such as setting server-side rules and polling may get sent to the back burner.

What can be certain is that all developers will have access to the same documentation for developing for EWS. Of course, the folks at the MacBU may have the Exchange Server Team's ear a little more than anyone else. Interestingly, an EWS bug will be a double-edged sword. One bug will affect Entourage, Outlook, Snow Leopard and any other EWS application, but so will one bug fix.

## Not too far down the road

### Leveling the playing field

Exchange parity has been a sore spot with corporate Mac users for nearly a decade but in the next 12-18 months that could all change. At least one more EWS client, Snow Leopard, and possibly a newer version of Entourage will be available. How about others?

Proprietary protocols, difficult-to-support protocols and workarounds will all have been replaced with open protocols and all Exchange clients will finally be communicating to Exchange Server the same way. The playing field for collaborative services will be level.

What happens next depends on the ingenuity of the client developers. Will most decide to offer full Exchange support to their customers by including every available feature or will some opt for "light" EWS clients? How will they distinguish their products from the competition's products?

### A market for new products?

New companies and maybe even some existing players may find the EWS arena appealing and offer more options than have ever been available. Online companies such as Google and Yahoo, for example, may decide to offer integrated Exchange support with their systems so that work Exchange calendars can finally be overlaid with online personal calendars without mixing information. Companies like Now Software may integrate their systems with Exchange to offer another interface choice for users. Or Omni Group may offer OmniFocus as a single robust task manager application that does nothing else except manage tasks very well.

Often seen as a barrier to rival products, Microsoft's server dominance may actually become a catalyst for new development and new methods for collaboration on more than just the Windows platform. So long as protocols such as EWS are made available to everyone then competition will flourish and consumers will benefit.

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## About The Author


***William Smith is a technical analyst supporting Macs in a Windows world in the Twin Cities, a six-year Microsoft MVP and is co-founder of the Entourage Help Blog <http://blog.entourage.mvps.org>. He can be reached at bill@talkingmoose.net.***

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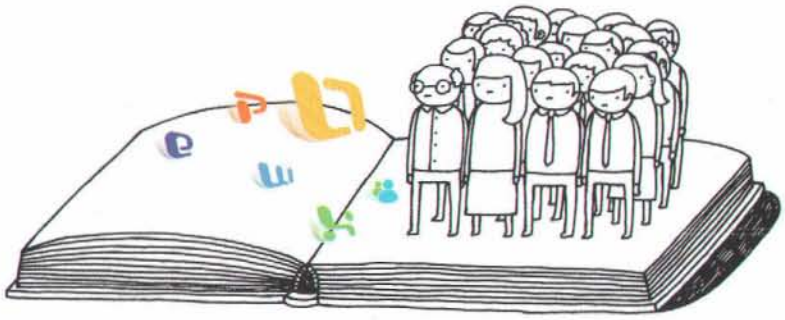

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# Integrating with Active Directory

## A look at third-party tools for leveraging your AD infrastructure

*By Greg Neagle, MacEnterprise.org*

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## Introduction

In enterprise environments, Microsoft's Active Directory is possibly the single-most common directory service. It's well suited to large companies with geographically separated locations, and scales very well to tens and even hundreds of thousands of users. In any organization that has many Windows computers, or any company that uses Exchange, it is the obvious and maybe unavoidable choice for a directory service. For these reasons and more, Active Directory is the 500-pound gorilla of directory services. Questions about integrating Mac OS X with Active Directory are among the most common questions on the MacEnterprise mailing list (http://www.macenterprise.org/mailing-list).

Given the ubiquity of Active Directory in enterprise environments, it's not surprising that Apple offers a solution for AD integration: the Active Directory plug-in for Directory Services. This plug-in has been covered well here and elsewhere: Michael Bartosh wrote an excellent article for the November 2004 issue of MacTech covering the AD plug-in that shipped with Panther. You can find it in MacTech's online archives – much of what it covers is still relevant. In October 2007, Philip Reinhart covered a few more tricks with using the AD plug-in and the `dsconfigad` command-line tool. And of this writing, Apple has an excellent whitepaper on integrating Mac OS X with Active Directory available here: http://images.apple.com/business/solutions/it/docs/Best_Practices_Active_Directory.pdf

Still, Apple's built-in solution does not meet every possible need you might have when integrating Macs into an existing Active Directory infrastructure. Fortunately, there are third-party tools that can be used to supplement or even replace Apple's tools. We'll look at a few in this article. While not intended to be a in-depth examination, we'll briefly touch on the main features of some of the third-party solutions.

## What's missing?

Before we look at third-party tools, it makes sense to talk about some of the "missing features" from Apple's offerings. Get ready for some three-letter acronyms:

### GPO

GPOs, or Group Policy Objects, are used by Active Directory administrators to help manage their Windows clients. They can be used to manage security policies, software installation, login scripts, folder redirection, and some application settings. They are similar in concept to MCX settings in managed OS X environments. Some organizations would like to be able to define GPO settings to manage Macs along with their Windows machines. Apple's AD plug-in doesn't support Active Directory GPOs.

### MCX

MCX is Apple's client management framework. Out-of-the box, there is no support for MCX settings in Active Directory. Some MCX options include extending the AD schema to include MCX attributes, deploying a dual-directory infrastructure where MCX records are stored in a secondary directory, or using a third-party replacement for Apple's AD plug-in.

### DFS

DFS, or Microsoft's Distributed File System (sometimes written "Dfs") is a method of making shared filesystems available via a network. This is typically used to provide fault-tolerance and/or redundancy, and to insulate users from having to know on which fileserver a given resource is located. It is roughly equivalent to automounted NFS shares where a resource can be accessed by a specific path, no matter which actual fileserver hosts it. While this is not really a function of the AD plug-in, Apple's built in SMB/CIFS client does not support Microsoft's DFS.

This is not an exhaustive list – certainly there are other features of Active Directory and Windows file services that are not supported by Apple's tools, or with which Apple's tools have difficulty.

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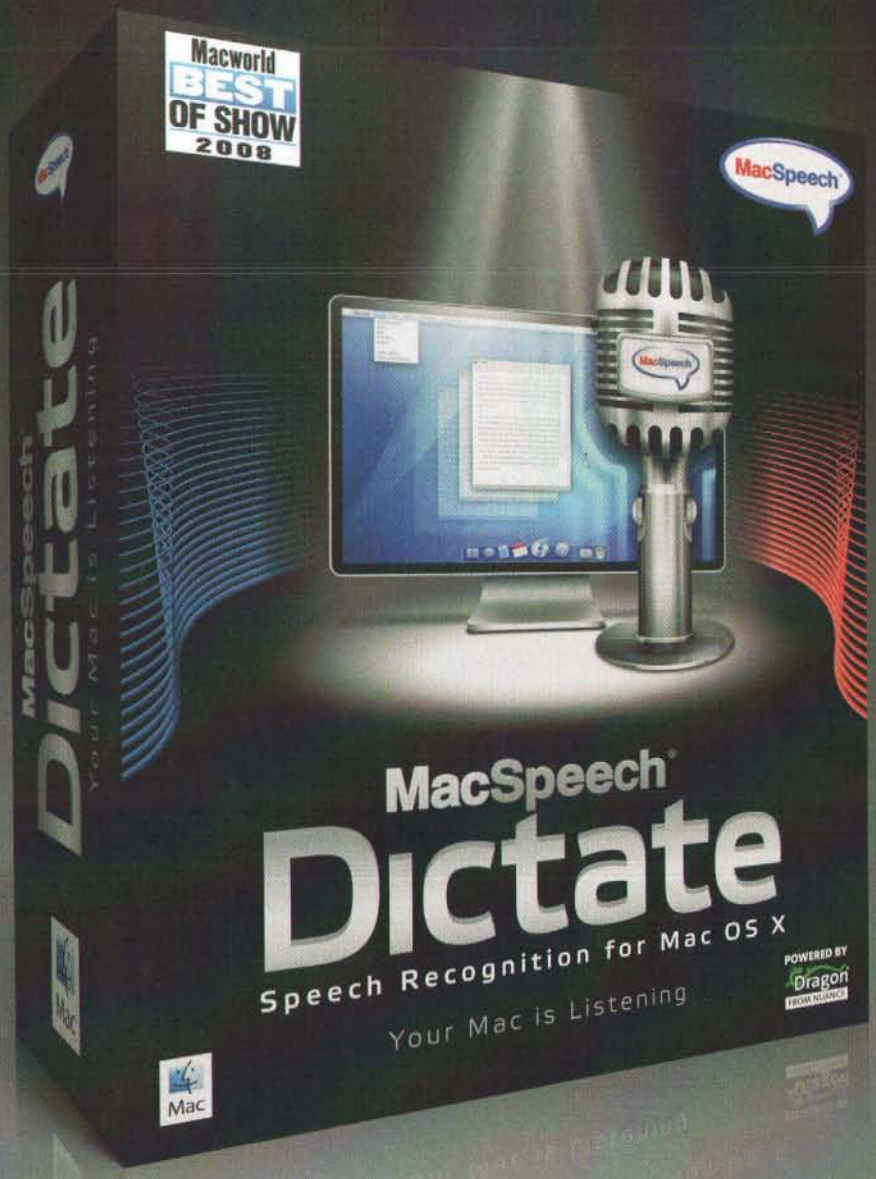


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## Select Third-party tools

### ADmitMac

Thursby Software has been providing tools to help Macs connect to Windows for many years. ADmitMac, currently at version 4, is a complete replacement for both Apple's AD plugin and the built-in SMB client. Some key features:

Requires no Active Directory schema changes
Supports DFS, even for home directories
Support for Active Directory shared printers
Support for MCX client management

More information is available at http://www.thursby.com/products/admitmac.html

### DAVE

Another product from Thursby Software is DAVE. It implements a subset of the features in ADmitMac. It operates as a replacement for Apple's SMB client, but provides less integration with Active Directory. See http://www.thursby.com/products/dave.html to learn more.

### DirectControl

DirectControl from Centrify is also an Active Directory plug-in replacement. Besides the obligatory support for Active Directory authentication, a major feature of interest is support for GPOs: Windows administrators can use standard Windows tools to define GPOs for Mac clients that can specify certain management settings for user and computers. The ability to use a single set of tools to manage users, groups, and manage computers, no matter the OS is an important one for some organizations. Centrify also offers DirectControl for Linux and UNIX, which offers the possibility of using Active Directory to authenticate and manage all your platforms. More information on the Mac product is available at http://www.centrify.com/directcontrol/mac_os_x.asp

### Likewise Enterprise

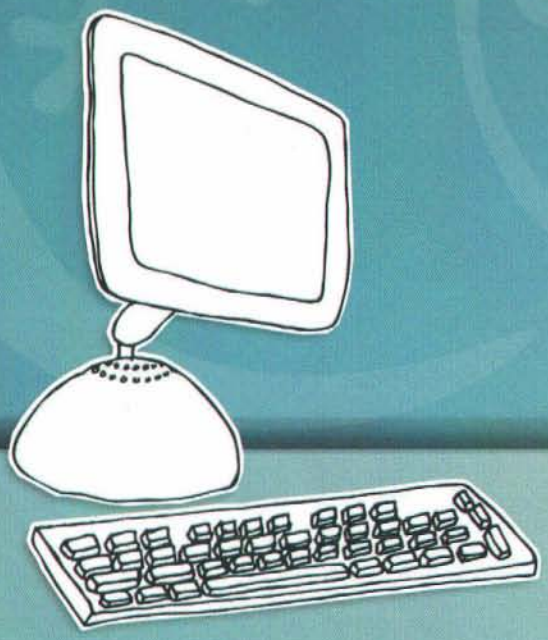
Likewise Enterprise is yet another replacement for Apple's Active Directory plug-in. A unique feature of this product is the ability to store MCX data in Active Directory without extending the schema. This is similar in concept to what Centrify's DirectControl does, but with two important differences:

Administrators can not only define Group Policy Objects using the Microsoft Management Console, but they can also use Apple's Workgroup Manager application to define Mac-specific management settings

Because actual MCX data can be stored in AD, a wider range of management settings are supported.

Likewise Enterprise is also available for Linux and UNIX, again making it possible to use a single directory service for all your platforms. Additionally, Likewise offers an Active Directory management console that runs on Mac OS X and Linux. Visit http://www.likewise.com/products/likewise_enterprise/ for more information on this product.

# Develop here.



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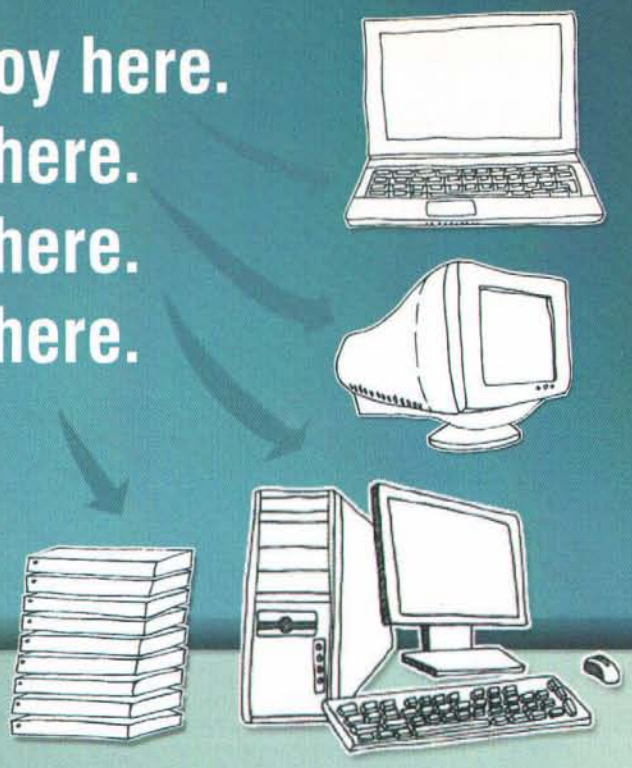

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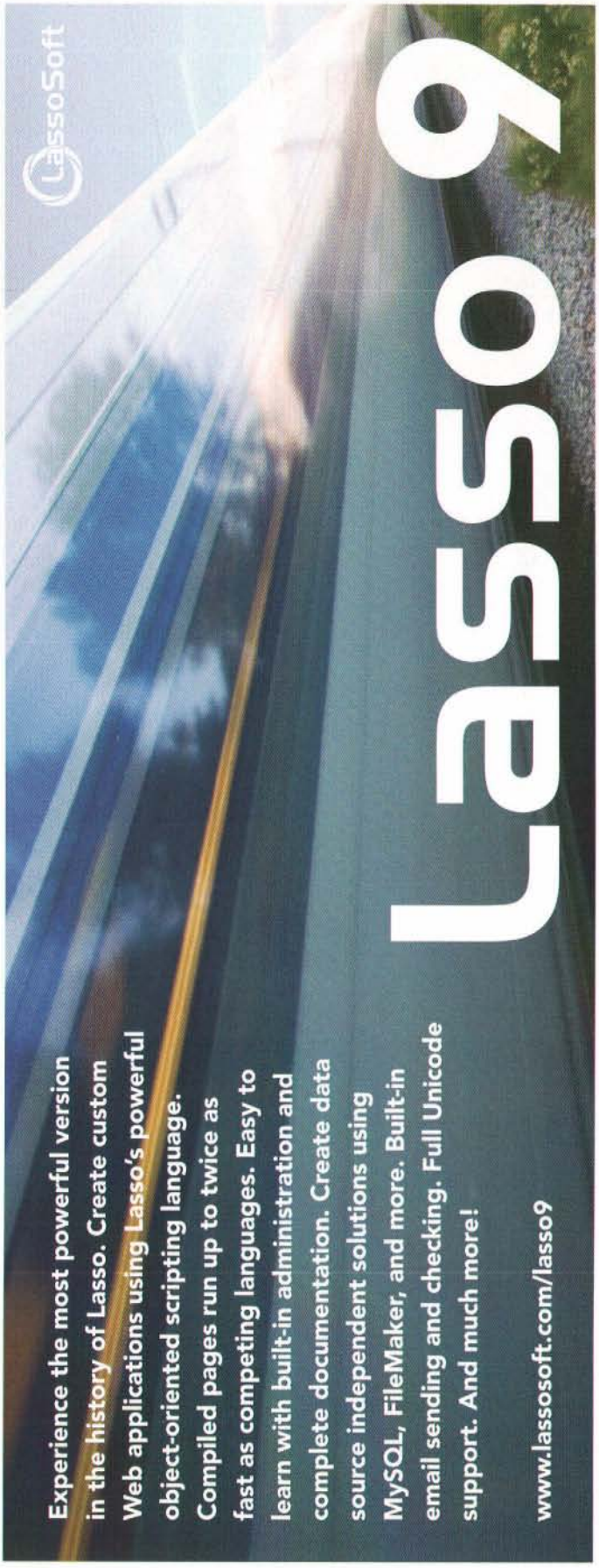


### ExtremeZ-IP

ExtremeZ-IP is a product from GroupLogic that provides Apple File Protocol services and printing services from Windows servers. Implementing ExtremeZ-IP on your Windows file servers allows Mac clients to connect via the native AFP client instead of the SMB/CIFS client. Since this is a server-based file sharing solution, it might seem odd to include it in this list of third-party tools. But GroupLogic has announced that Extreme-IP 6, due this year, will provide support for Microsoft DFS. With ExtremeZ-IP 6, Leopard (and later) clients will be able to use AFP to connect to Microsoft DFS shares. As a server-based solution, it can be used in conjunction with many of the client-based solutions mentioned above. You can find out more about ExtremeZ-IP at http://www.grouplogic.com/products/extremeZ-IP/

## Active Directory Integration Cheat Sheet

To wrap things up for this overview, the table below lists the solutions mentioned in this article with a matrix of some of the features not directly supported by Apple's built-in tools. If Apple's bundled solutions for Active Directory and Windows file server integration don't meet all your needs, you have some additional options to explore!

| | Directory Service plug-in? | Supports DFS? | Use MMC to edit GPO? | Use WGM to edit MCX? |
|---|---|---|---|---|
| Apple AD plugin/SMB | Yes | No | No | With schema extension or dual-directory |
| Thursby ADmitMac | Yes | Yes | No | Yes |
| Thursby DAVE | No | Yes | No | No |
| Centrify DirectControl | Yes | No | Yes | No |
| Likewise Enterprise | Yes | No | Yes | Yes |
| ExtremeZ-IP | No | Yes (version 6) | No | No |

MT

## About The Author

***Greg Neagle is a member of the steering committee of the Mac OS X Enterprise Project (macenterprise.org) and is a senior systems engineer at a large animation studio. Greg has been working with the Mac since 1984, and with OS X since its release. He can be reached at gregneagle@mac.com.***

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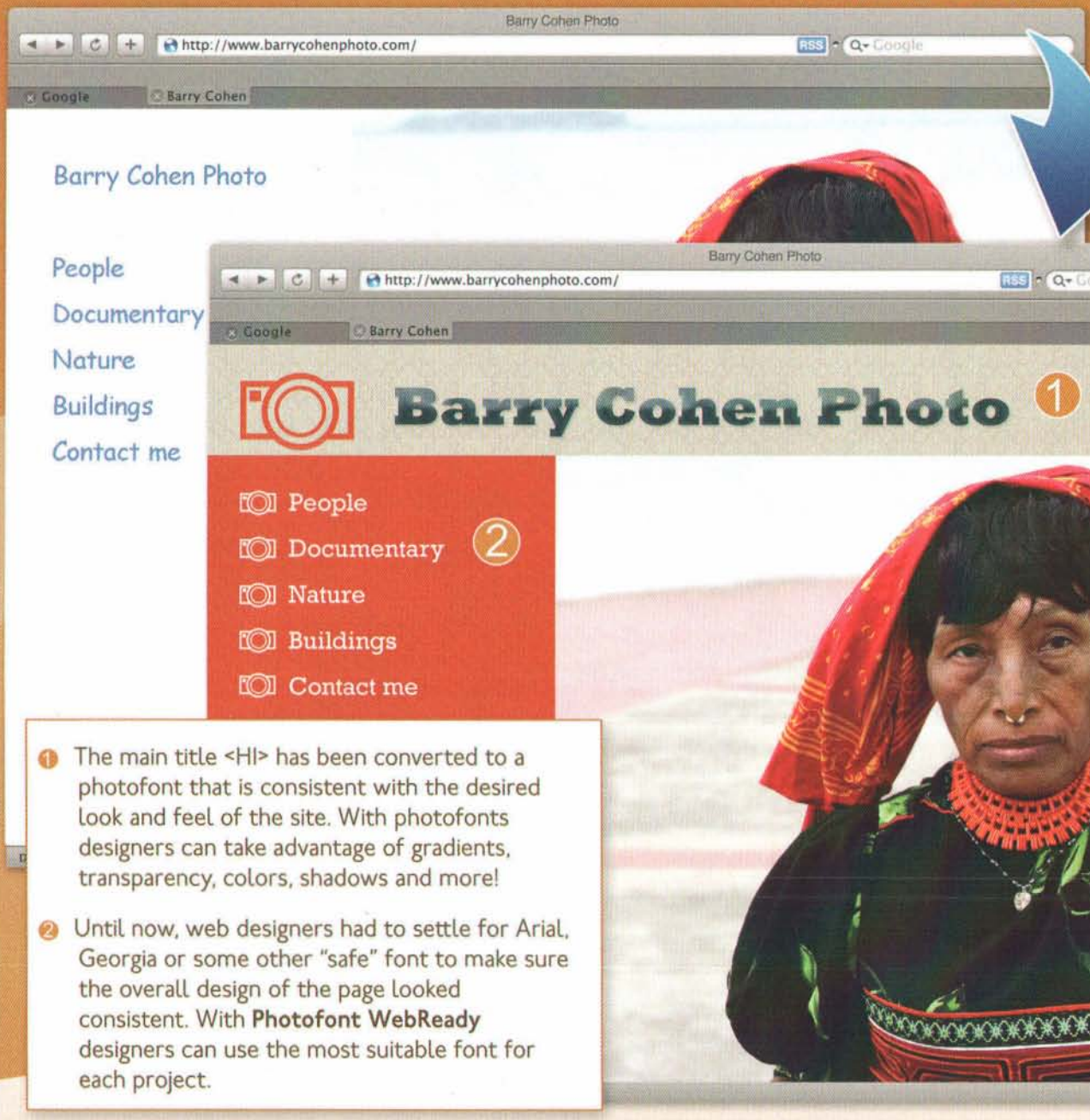


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# Introducing Unity: The Little Engine that can

## Your first step into games development needn't start with a C++ handbook

by Will Goldstone

Most interactive developers these days still seem to take for granted that 3D game development is the reserve of the dedicated C / C++ coder, requiring years of disciplined study and collaboration to break into. In the past few years, a small Danish company has been working feverishly to bust that myth wide open, with their innovative game production package, *Unity*.

With close ties to the open source movement, Unity immediately comes across as a powerhouse of a package, with all the down-to-earth common sense you'd expect from community driven projects like Wordpress. Utilizing Mono, the open source .NET library, Unity started life in 2003 as a Mac-only package, developed by a 3-man team (then known as Over The Edge Entertainment). Its initial concept was born out of collaboration between developers Joachim Ante and Nicholas Francis, who met online and made their first game engine together for a project they co-authored. In developing the engine, they sought to produce what they referred to as a *generic* game engine, which later became Unity. With the arrival of David Helgason, the trio resolved to release Unity commercially. Fast-forward to today, and Unity is on the verge of releasing version 2.5 (OSX and WinXP/Vista) and has bases of operation in Europe and San Francisco. Major middleware contracts with Nintendo and Apple tie Unity in with the latest, most innovative technologies that are taking games to a wider audience - the Wii and the iPhone.

Starting with a simple GUI, and concepts that make sense to coders and non-coders alike, the developers of Unity have created a rarity of an application that enables new users, with neither a design nor programming specific background to get started. For students wishing to get into the games industry there often appears to be an insurmountable learning curve, one which few manage to successfully, and indeed enjoyably, scale. Unity Technologies (UT) have tackled that curve head on - creating a set of tools that do not adhere to a particular game genre or development task, choosing instead to put emphasis on ensuring that all elements of their interface make logical sense. With this approach, UT has managed to produce a package that introduces the concepts of game design, and allows the user to implement some of them, without even taking their first step into its script editor. This approach is pivotal to Unity's success, as it takes time to charm the user - inspiring them with enough developmental simplicity at the outset that each new concept learned feels more like a reward than a chore.

Bugs and logic gaps in an interface can be a massive put off, especially when faced with any new software, but with Unity, this is rarely a concern. Whilst being as stable as any competitor, bugs and issues found are more than covered by Unity's welcoming and talented surrounding community. With excellent documentation, searchable scripting guides featuring practical examples and even video tutorials, development in Unity feels more like a "Welcome to the club!", than a conscription. Any question you could have is either covered by documentation, the integrated bug reporter (with genuine dev team support via email), free example project resources or by an army of devoted staff and fans on the forums, wiki and IRC channel (#unity3d on irc.freenode.net).

While still relatively obscure when compared with Adobe or Microsoft packages, Unity Technologies' package is on the verge of greatness. In this article, we'll take a look at how Unity is currently the best bet for developers, young and old, to make the first leap into the fascinating world of 3D game development.

## Simplifying the Complex

You simply have to look at trends in GUI focused IDEs these days to see that the market for hobbyists and beginners has never been easier to breach. From XHTML web development to music composition, there is a tool available to the everyday user to get them started on their chosen path. Apple leads this trend with products such as iWeb, which has allowed users with no experience of code to publish online content of their own making

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without writing - or even seeing - a single tag. Unity takes this concept forward - providing a readily integrated environment, powered by a sophisticated game engine behind the scenes. This ***TOOLSET*** approach is not a new concept for game engines per se, but as an all-round package for game editing and scripting, Unity does for game development what products like Adobe's ***DREAMWEAVER*** do for web design – providing powerful tools to carry out menial tasks whilst the user concentrates on making a great product.

Taking a different approach to its main competitor, GarageGames' ***TORQUE*** game engine, Unity hides its engine source behind the GUI, letting the user concentrate on getting the game made. With this approach, no time is lost in learning how the mechanics of the engine itself work - placing trust in the Unity development team to maintain the engine - and working with them in requesting new features. Many code purists have criticized this approach, complaining that they would prefer to be able to tweak the engine's source manually, but others have praised Unity workflow highly, stating time saved in development anywhere from months to years.

Historically, approaches like this have proven to be the key to accessing industries previously out of reach of many young enthusiasts. Creating accessible tools that present concepts of production logically should be the responsibility of software teams - this is the best hope for pushing their industries forward as it doesn't exclude the creative talent otherwise put off by elitism and counter-intuitive methodologies.

# Unity Interface

Beginning with the building blocks of all projects - Assets - the GUI has a **Project** window (fig.1, no.5) which links directly to the Assets folder of the open project - saving any asset into the **Assets** folder of the project makes it instantly visible in the 'Project' window, and if changes are made in a third party application it will import automatically when Unity is switched to.

The *Scene* window (fig. 1, no.1) is a rendered view of the active scene or level, and what the Unity developer uses to build everything in their game. Using a simple drag and drop from the *Project* view (which could be compared to the Library in Adobe's Flash), the user can introduce any *asset* as an active *game object* by dropping it into this window.

The Inspector (fig.1, no.3) is available to fine tune any *game object* or *asset's* Transform – its position, rotation and scale - and adjust values for any other attached components.

The *Scene* is accompanied by the *Hierarchy* window (fig.1, no.2) - which displays an alphabetical list of active *game objects* in the open scene. This allows easier access than attempting to select objects which are not currently in view in the Scene Window.

Completing the GUI are the *Game* window (fig.1, no.4) and Play controls (at top of the interface), allowing the developer to instantly test their level with on the spot compilation.

The layout of the interface is also completely customizable, and as of the latest release, version 2.5 (in beta at time of writing) features *Creative Suite* style docking on all sections.

# Unity Concepts

## Assets

Assets are the items from which the user constructs the game. These can be created within Unity - scripts, primitive objects, terrains, textures, or in third party applications - textures in

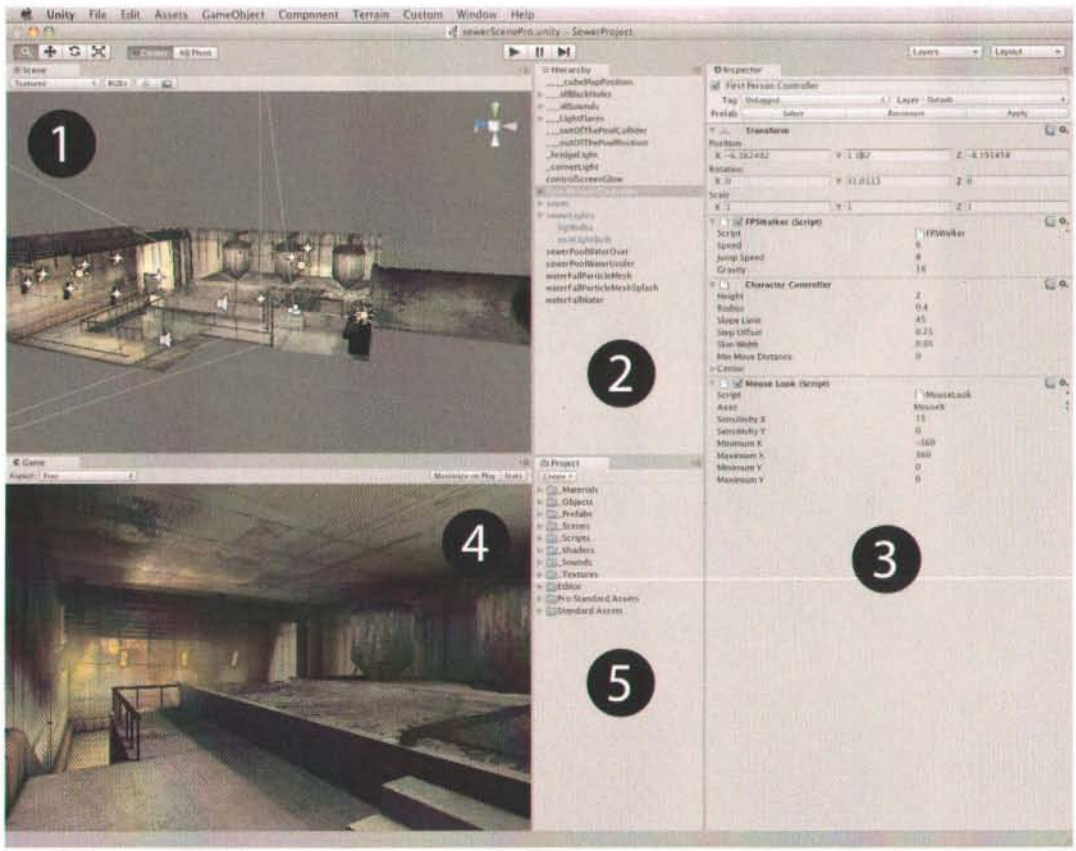


**Fig.1 Unity Interface**

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## Game Objects

Once an asset is added to a level it becomes a Game Object (GO). These objects are the key to Unity's approach. They can begin life as nothing but an empty object containing only Transform information - Position, Rotation and Scale. GOs can be created empty from the menus in Unity (fig.2) or as fully fleshed out objects such as Lights, Primitive Shapes, GUI elements, Cameras, Particle Emitters and more. These objects however are simply empty GOs with the relevant Components attached to them, making them what they are. For example - a Camera object is simply an empty GO, with a Camera Component, Rendering Components and an Audio Listener Component attached - again this is key to the straightforward nature of the workflow - the user can introduce this object from the scene with the components readily attached and configured - they then have control over the settings of these components to customize the object.

**Fig.2 – GameObject Menu.**

## Components

Components are the core elements of the game engine simplified into game functions; they add behavior, or functionality to an otherwise lifeless object. For example should you want a simple scene set up with a ball bouncing on the ground -

i) Having created the ball and ground (as simple as adding a flat cube and a sphere from the *Game Object* > *Create Other* menu), simply add a *Rigidbody* component (fig.3) to the sphere to invoke the powerful Ageia PhysX engine, which immediately takes charge of the ball, applying mass, and therefore gravity to the ball.

ii) Add *Collider* components to the sphere and the cube, and the objects will behave naturally when colliding - the ball will fall and rest on the ground.

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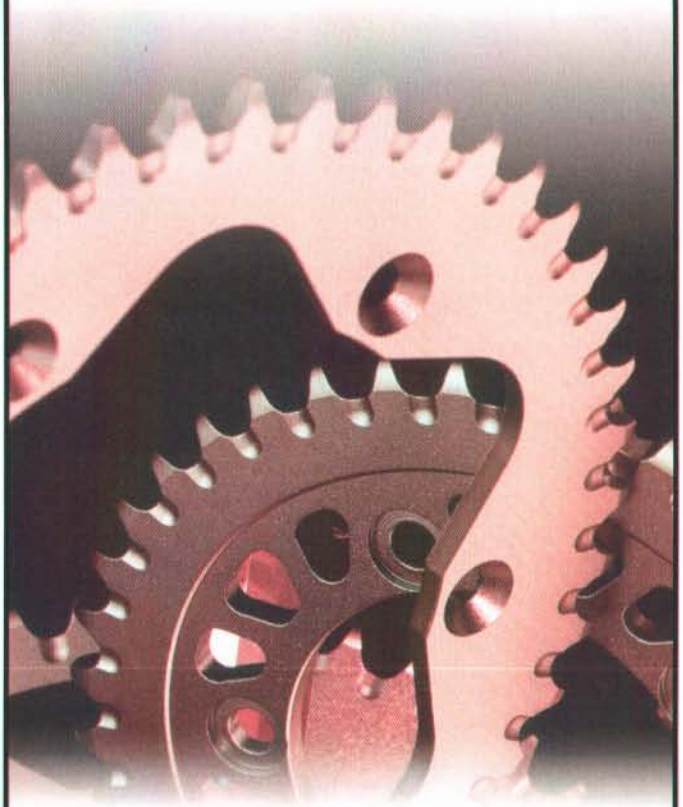

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These two steps would ordinarily take considerable coding effort that ends up as time lost by developers who must either learn how to write physics behavior and script collisions by hand or already know how to do this, but have no pre-built tool to get such menial tasks done quickly. This leaves the user free to experiment with settings (variables) of the components - for example mass of the Rigidbody component - defining how it will fall - adding a *Physic Material* to it to induce friction (and therefore, bounce). Such settings are all adjustable via text fields, tick boxes and other simple form elements in the Inspector. Put simply, the *Game Object > Component* system gives the user more time to experiment with style and gameplay, instead of time spent fixing bugs and writing engine source.

**Fig.3 – Component Menu, Physics section.**

This is just one example of *component* usage and - bearing in mind that Scripts are also considered as components, the object – component system offers a limitless potential for expansion. Using the example above, we could add the following script to the sphere GO:

```
var explosion : GameObject;

function OnCollisionEnter (collision : Collision) {
    Instantiate(explosion, transform.position,
transform.rotation);
    Destroy(gameObject);
}
```

Here we simply add functionality that removes the sphere from the game (the *Destroy* command) when it collides with another object, and the object that is tied to the *explosion* variable will be created, or spawned in the game world, this is known as *Instantiation*. Because this variable is declared outside of a function it becomes what is known as a *Member* variable of that script.

Scripts can be created from the Assets menu, and edited using Unitron - Unity's standalone script editor. With the desired object

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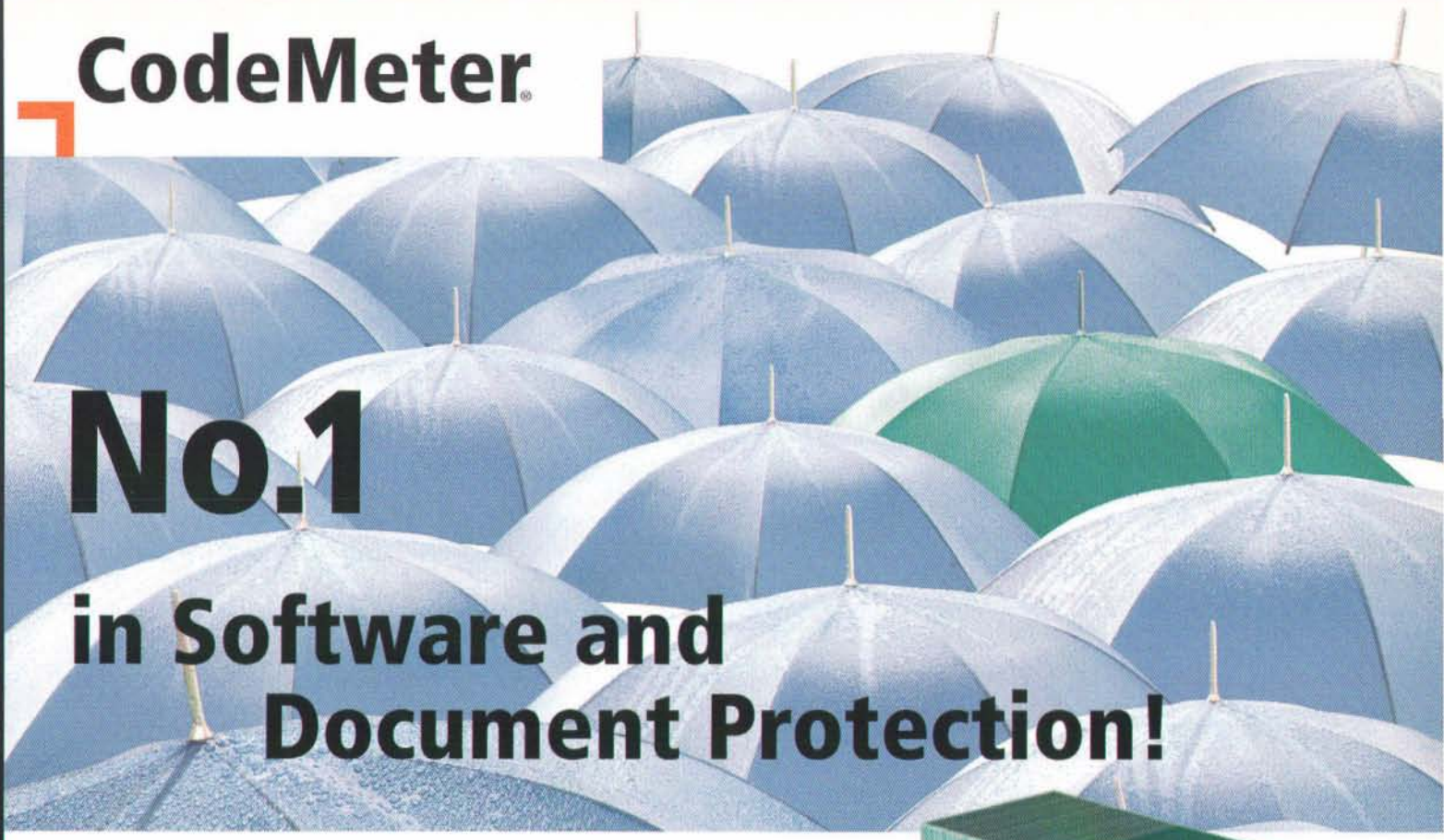

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selected, the script can then be applied from *Component > Scripts* top-menu, or dragged and dropped from the Project window onto the *Game Object* the user wants to apply it to.

Once the script is applied, the user is then able to drag and drop the object of their choice to the *explosion* member variable in the Unity interface. For example we'd likely create a particle system for the explosion - which will be instantiated by the script upon impact, creating the illusion of the object's flaming destruction. The script, once attached, will be seen as a component of the sphere in the Inspector (fig.4), the variable in the script becoming a drop-down or drag & drop setting, awaiting the selection of a Game Object.

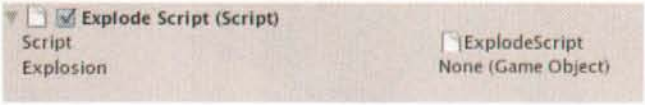


**Fig.4 – Explosion Script seen as a component in the Inspector area of the GUI.**

### Prefabs

Comparable to *Movie Clips* in Flash, Unity's *Prefabs* are effectively saved Game Objects which are built in the Scene, and saved to the *Project* window, to be cloned, or instantiated later. In a game, the exploding sphere could be a bomb being dropped, but the user would want to drop bombs many times, and at their chosen moment. Therefore this item would be built in the scene, and the components it requires would be added, and then this would be saved into an empty 'Prefab', which can easily be created from the Project window. The original copy is then deleted from the scene and multiples can then be created from this Prefab.

## Getting Started

Any Unity Project begins with the Application creating a root folder for the project, and within this, child folders called *Assets*, *Library* and during runtime, *Temp*. Making a new project with Unity means either starting from scratch, or as most new users will do, importing the *Standard Assets* (or *Pro Standard*, using the software's pro license) package available in the new project dialog. These free-to-use assets are a great starting point for the new user, and are prime examples of the kind of assets essential to getting started with game projects. One such example of this is the *First Person Controller* prefab, which is a ready-to-use first person player, complete with camera component, control scripts and a *Character Collider* for game world interactions. Touches like this give the beginner an ideal kick-start into production, as they can reverse-engineer such assets, observing the combinations of components with mind to understanding game mechanics.

With Assets at the ready to build the game, the developer then creates each level (or *Scene*), of the game, either placing objects into the scene for its start - an environment for example - or instantiating new objects during runtime using the Prefab system.

In building a rocket launcher, for example, the developer would save the missile model into the Assets folder of their Unity project, then return to Unity and drag and drop from the *Project* window (the mirror of the Assets folder) into the *Scene*. They would add scripts, and other components managing the missile's behaviour, to the Scene either by dragging and dropping, or by selecting components from the main menu. They would make a new prefab in the Project Panel, name it "missile" and then simply drag and drop the item from the Hierarchy (a list of items in the Scene) onto the new Prefab in the Project panel. The original instance is then deleted from the Scene, leaving a duplicate with a

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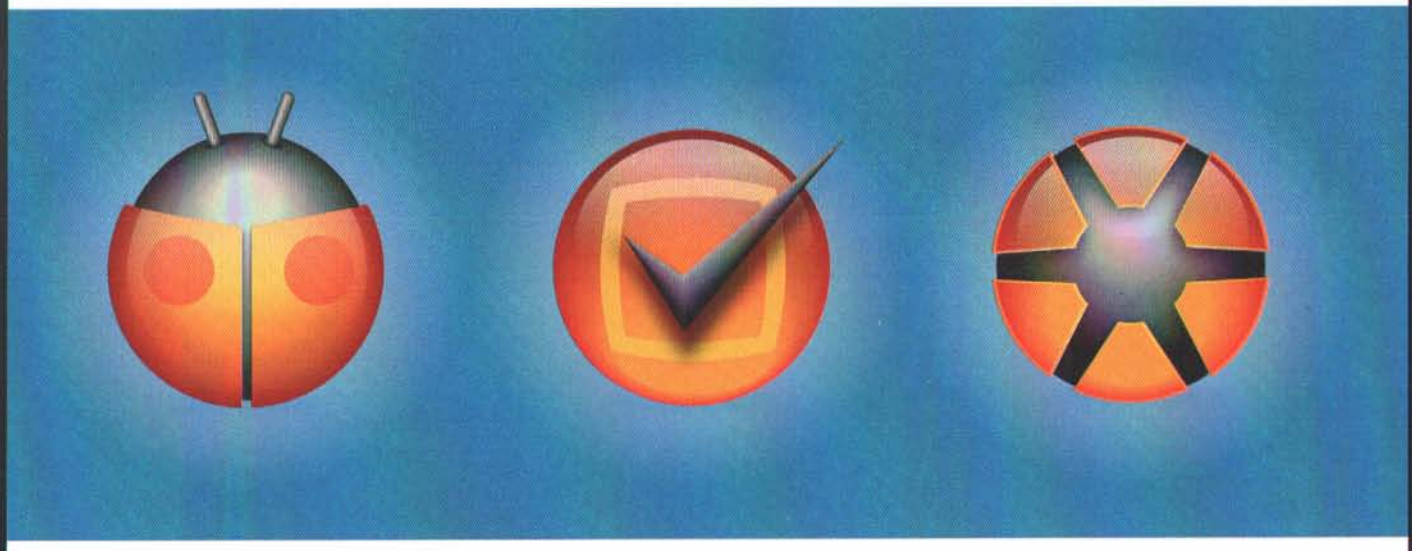

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## Integrating Scripts

With a developmental approach that lends itself to completely expandable ways of working, Unity lets the developer effectively build their own tools within the Inspector. The developer can choose to write scripts in either C#, Javascript (albeit Unity's own variant) or Boo (a variant of Python), the Member variables of which can form parts of the Unity GUI itself, allowing them to instantly adapt Unity to their own way of working. Scripts may also address any component attached to any object by referencing the component name, and choosing a command from the Behavior class.

Lets look at a simple example. With the following script (in Javascript), we'll allow a First Person Controller object to interact with another object – a 3D house model, featuring an animated door.

The script begins with 5 variables, all with datatype declarations; the first two of which also have set values within the script :

```
private var doorOpened : Boolean = false;
private var timer : float = 0.0;
private var theHouse : GameObject;
var doorAudio : AudioClip;
var doorShut : AudioClip;
```

Variables such as these will appear as component parameters in the Inspector, however, given that `doorOpened` (a Boolean; true/false switch), `theHouse` (an object reference) and `timer` are only used locally within the script – they are not something the user will adjust - the *private* prefix is added. This stops them becoming Member variables, so will not be shown in the Inspector, to avoid visual clutter. The final 2 variables are Members, and will require assignment of objects of their specified data type in the Inspector (fig.5).

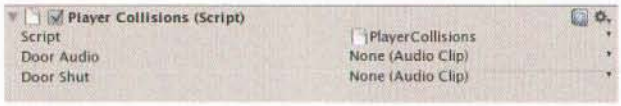


**Fig.5 – Player Collisions script awaiting two audio clips to be tied to Member variables.**

The first function in the script is `Start()`, which can be used to assign defaults for the first time the script occurs in each scene. Such defaults are utilized within the rest of the script, in this instance, it is used to set `theHouse` variable:

```
function Start(){
    theHouse = gameObject.FindWithTag("house");
}
```

Utilizing the `FindWithTag` command, the script assigns the object with the tag `house` to the private variable `theHouse`, declared earlier. Similar to the *Instance Name* concept in Flash, tags are assigned to objects in the Inspector (fig.6), and are simple ways to refer to them within scripting.


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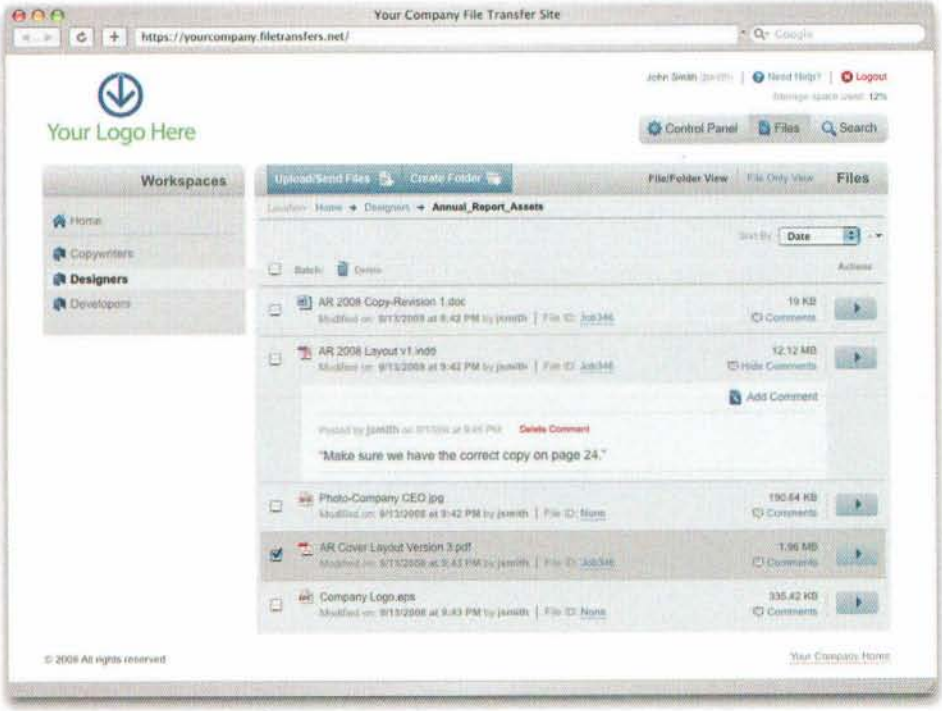


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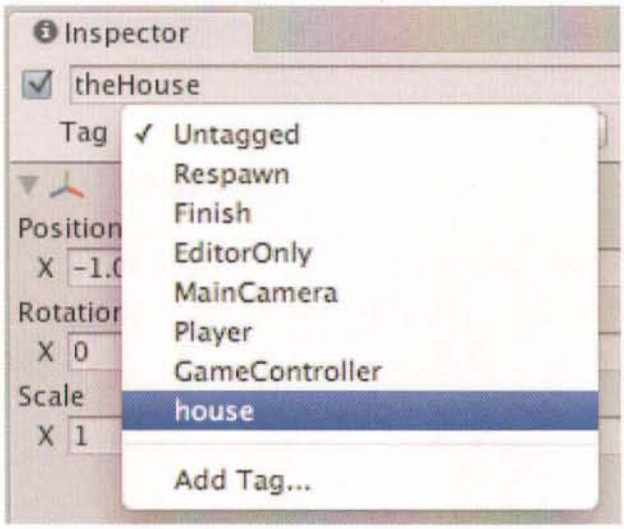


**Fig. 6 – Assignment of Tags with the Inspector.**

The script then features a function specifically for Character objects, called OnControllerColliderHit(), which registers all collisions with other objects, allowing the use of IF statements to check for particular objects:

```
function OnControllerColliderHit(hit:ControllerColliderHit){
    if((hit.gameObject.tag == "houseldoor") && (doorOpened ==
false)){
        openDoor();
    }
}
```

Upon collision with an item tagged `houseldoor`, these conditionals will run the `openDoor()` function, if the `doorOpened` variable is false. This means that the user simply has to tag the door child object of their house model with this tag, and the collision detection will trigger the `openDoor()` function :

```
function openDoor(){
    doorOpened = true;
    theHouse.animation.Play("dooropen");
    audio.PlayOneShot(doorAudio);
}
```

This function sets the doorOpened variable to true, which avoids retriggering the function in the collision detection earlier in the script – without this, the door could accidentally loop opening, any time the player collides with it. The second command finds the animation component, on the object applied to variable `theHouse`, and plays an animation named `dooropen`. The user specifies these animation names on models in the Inspector, having selected the particular Asset in the Project window (fig.7).

The **dooropen** animation within the original house model occurred from frames 11 to 40, and by simply informing Unity of this timeline information, scripts can pick out the particular frames and play them, using the name parameter. Finally, the `openDoor` function plays the audio file assigned to the `doorAudio` variable, using the `PlayOneShot` command.


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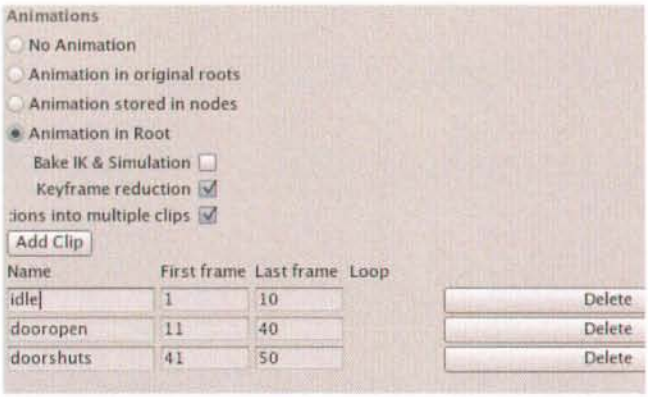



**Fig.7 – Animation clips can be added or deleted, and frame positions altered in the Inspector for the asset.**

With the door open, and by consequence the `doorOpened` Boolean switch set to true, Unity's `Update()` function comes into play. Checking every frame, `Update()` could be likened to `EnterFrame` in Actionscript, and is where the user places commands or listeners that require constant attention. In this example, Update() is employed with two IF statements, the first listening for the `doorOpened` boolean to become true and the second for our `timer` variable to have counted five seconds:

```
function Update(){
    if(doorOpened){
        timer += Time.deltaTime;
    }
    if(timer >= 5){
        shutDoor();
    }
}
```

The first IF statement is simply present to add to the value of timer, which it does so using the `Time.deltaTime` command – in simple terms, a real-time counter running independent of game framerate. Upon reaching 5 seconds, the second IF then triggers the final function, `shutDoor()` :

```
function shutDoor(){
    doorOpened = false;
    theHouse.animation.Play("doorshuts");
    audio.PlayOneShot(doorShut);
    timer = 0;
}
```

This function effectively cleans house. It resets the Boolean switch, plays the door closing animation (and its accompanying audio file), and resets the timer back to zero. Now the player is free to collide with the door again, causing the whole process to start from scratch.

By building simple behaviors, which address parts of Game Objects as components, scripting for Unity is straightforward and, crucially, fun to learn. For beginners who may be unfamiliar with scripting, the forgiving Javascript syntax is a big plus, and those thinking of making the leap from Flash to 3D development will find the similarities in concept and execution most beneficial.

## Play, Tweak, Build!

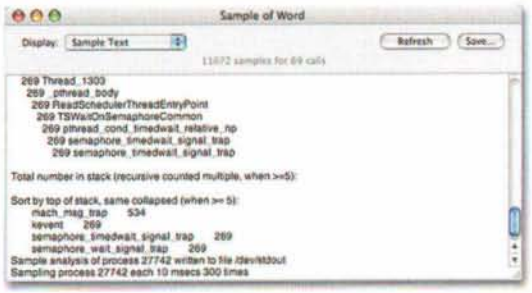
Whilst other game engines keep their game world editors separate from compilation and debugging, Unity believes in one application to rule them all. With its Game window and play controls, the developer can compile almost instantly and test the open scene as it will look when built. The advantages of this are obvious, and make testing and experimentation with gameplay a joy. Having the ability to play, stop, alter values in the inspector is good enough but Unity goes one step further, invoking a full *Play* mode. This means that at soon as the game is being tested, any values experimented with in the Inspector, become part of that test.

For example - the user want to test an enemy's line of sight in a shooter. Pressing Play activates the Game window, and the user can test enemy response. However, without stopping the game, the user can adjust variables in the Inspector and see results instantly in the Game window. This way, the user is able to try out a number of different adjustments - and if they forget what changes have been made, the settings revert as soon as Unity is switched out of testing mode. Another great example of its emphasis on experimentation in practice.

Building a game project is the act of constructing an executable version of the game. In putting together a build of any Unity game, the *Build Settings* (fig.8) offer several options. Having started life on the Mac, Unity is well prepared to offer builds in Mac PowerPC, Intel and Universal Binaries. In addition to this, there are Windows Standalone, Web Player (standard, and with server streamed assets), Dashboard widgets, and with the relevant licensed add-ons, iPhone and Wii. This dialog then offers one-click complete compilation and build export in one - the user simply selects the levels (or Scenes) required in the build, and clicks 'Build'. Simple, effective.

**Fig.8 – Build settings allow compilation of an entire Unity project into various deployment formats.**

# Does

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## The Path Ahead

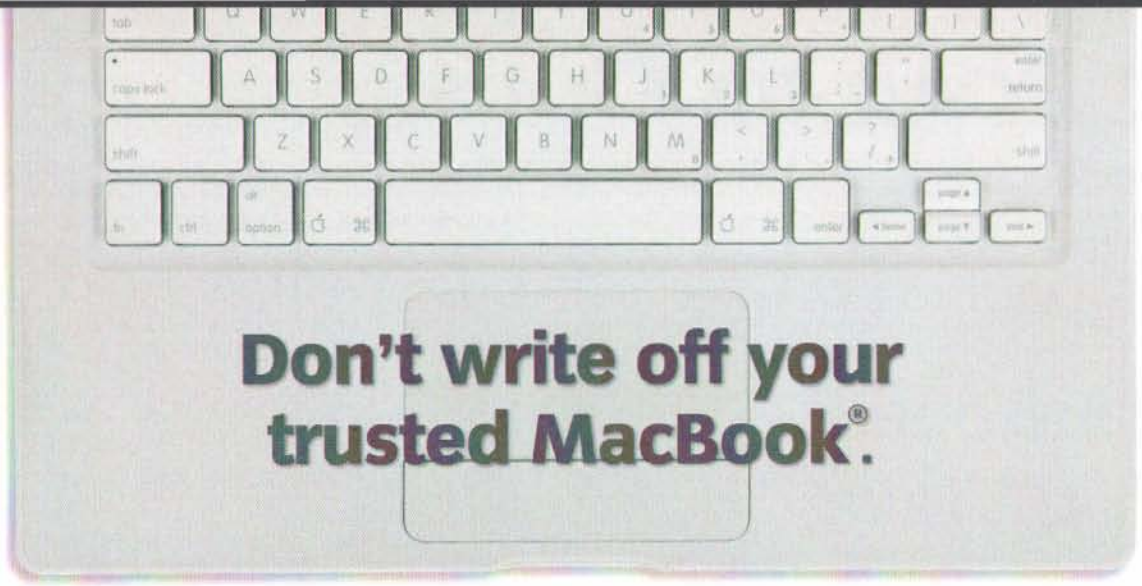
With 2008 having already seen several point releases and new features / deployment platforms being added to the Unity package, the future looks bright. A key factor as far as many are concerned is the leap to the PC, which could be a tipping point for Unity's potential in the development tool market. Whilst I've witnessed many companies reporting the purchase of a Mac purely for Unity, it is certain that many production houses will have unfairly overlooked Unity in the past few years due to its Apple roots. With version 2.5 due out in early 2009, Unity makes its first step onto XP/Vista. Having fixed many bugs, and added new features, plus an interface overhaul (although the interface's features remain the same as shots in this article), the latest version should see the buzz around Unity explode with their newfound market in PC users.

Having taken their time to work Unity up to a reliable, intuitive standard before heading to the PC says more about the UT team than any review—meshing business sense with a knowledge of their audience should see Unity's popularity snowball as new users line up to discover that at last, they too can be a game developer. Here's hoping that a new generation of creative people discover this excellent tool and point the future of gaming away from endless FPS games and towards one with more *Katamari Damacy* and *Little Big Planet*.

Although this article has barely scratched the surface of what Unity can do, hopefully it has shown you a little about how it works, and how it makes my life and many developers/lecturers' lives easier and more fun. What is also worth noting are the things that space constraints have forced me to omit. I haven't had time to praise the excellent Terrain Editor and its height/texture painting, the excellent in built render effects, network gaming, asset server, plug-in system, and masses of freely downloadable content/expansion available on the wiki—but why not find out for yourself, and give the trial version a spin? *Unity3d.com*.

## About The Author

***Will Goldstone is an interactive designer and lecturer based in Bournemouth, on the South Coast of England. You can get in touch with him via will@willgoldstone.com.***



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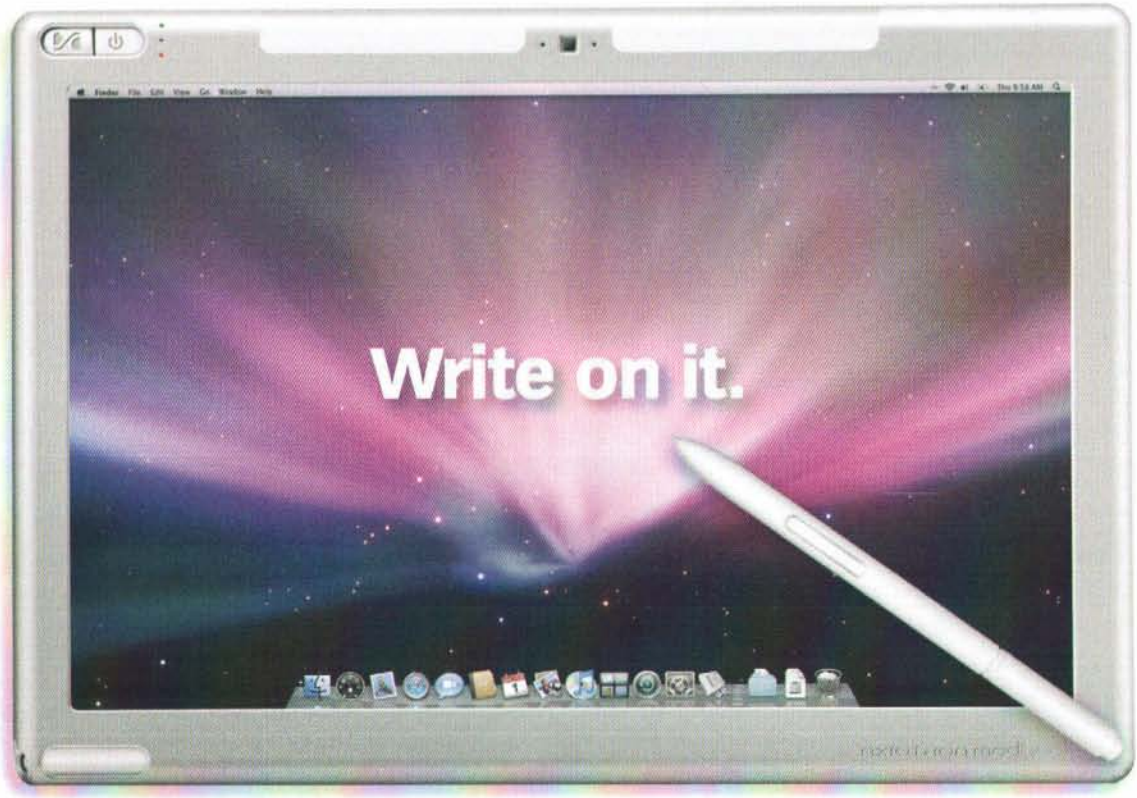


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by Dave Dribin

# A Window with a View

## Custom NSViews

## Introduction

In previous articles, we've talked a little bit about views and controls and worked with plenty of system supplied views. As a refresher, Figure 1 shows the inheritance hierarchy for controls we've used before: `NSTextField` and `NSButton`. In this article, we're going to concentrate on writing our own custom views.

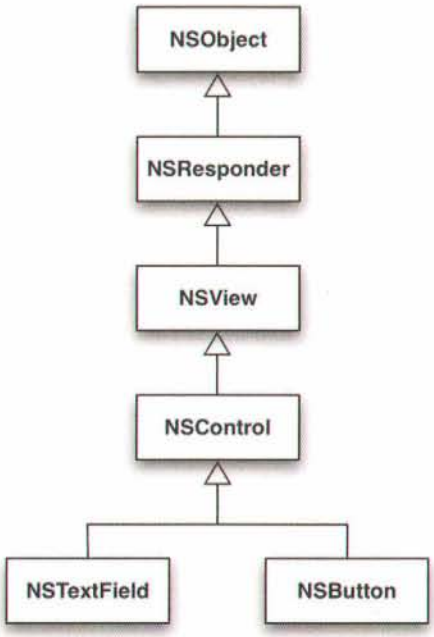


**Figure 1: Control inheritance hierarchy**

Windows, which are instances of `NSWindow`, contain one or more views, and views are responsible for drawing output as well as accepting user input. The `NSResponder` class is responsible for handling user events, such as keyboard and mouse events. The `NSView` class is responsible for drawing to the screen and, by inheritance, can also handle user events. Writing custom views is sometimes necessary if the system provided views are not appropriate. Besides, writing custom views is fun!

## View Hierarchy

Views are arranged hierarchically inside a window. Each view can have child views, called *subviews*, and a single parent view, called a *superview*. While any view can have subviews, only certain views are designed to have subviews. For example, controls, like `NSButton`, are not meant to contain subviews, but `NSBox` is.

Each window has a view that represents the entire window's visible area called the *content view*. The content view is the root of the view hierarchy. The window in Figure 2 has a view hierarchy as shown in Figure 3.

**Figure 2: Window with text field and button**

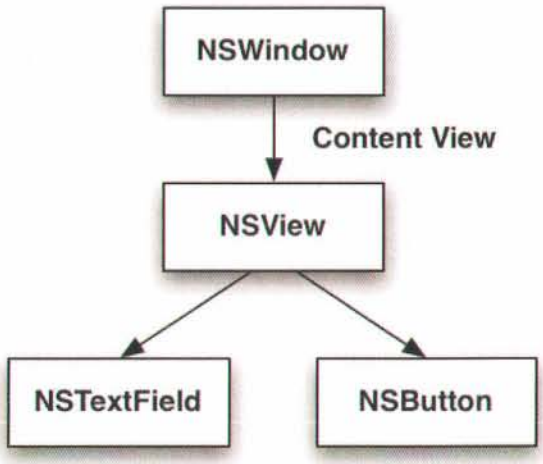


**Figure 3: View hierarchy**

If you create your user interface in Interface Builder, it will create the view hierarchy for you. You may need to be aware of the view hierarchy when accessing views in code, though, which requires understanding the concepts of the view hierarchy.

# View Geometry

Windows represent a two-dimensional rectangular area of the screen. The origin of the coordinate system that represents windows in AppKit, point (0.0, 0.0), is located in the lower-left corner, with the X-axis increasing to the right and the Y-axis increasing upwards. For example, if we have a window that is 200 pixels wide by 100 pixels high, the coordinate system and origin is shown in Figure 4. This can be a point of confusion if you have done graphics programming on other computer systems, where the origin is located in the upper-left corner.

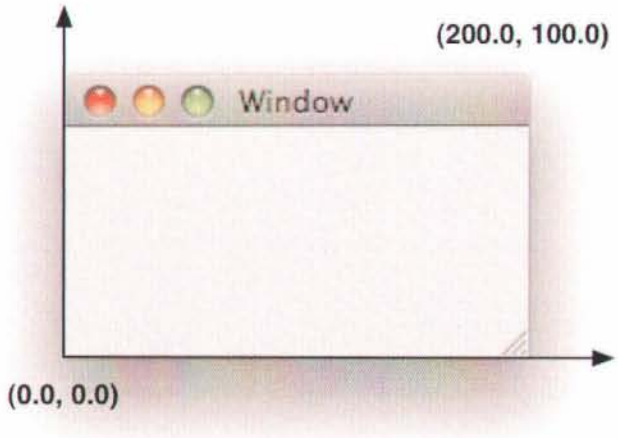


**Figure 4: Window geometry**

Before we discuss the geometry of views, we need to discuss the various geometric data structures in Cocoa. The Foundation framework defines three basic geometric data structures: `NSPoint`, `NSSize` and `NSRect`. These are C structures, not classes, for performance reasons. The `NSPoint` structure represents a geometric point with X and Y coordinates, and is defined as:

```
typedef struct _NSPoint {
    CGFloat x;
    CGFloat y;
} NSPoint;
```

Note that Foundation also defines its own floating point primitive, `CGFloat`. The "CG" prefix stands for Core Graphics, the low-level graphics framework on Mac OS X. Prior to Mac OS X 10.5, `float` was used instead of `CGFloat`. The reason for the change has to do with the transition to 64-bit, but it isn't really that important for what we are talking about. What is important is to realize that the coordinate system in Mac OS X is based on floating point numbers, not integers.

While coordinates are floating points, and it is possible to have non-integral components, we generally only use integer values when dealing with screen coordinates, as each screen pixel lands on an integer point. If you see some weird drawing artifacts, it may be due to your use of non-integer coordinates. This can happen when doing division, for example. As screen resolution increases, however, points may not match up with integer points, and using non-integer coordinates becomes less of an issue. In the meantime, it's good to check for non-integer values if you have a drawing problem you are trying to solve.

To set or get the individual X and Y coordinates of a point, just access the structure members directly:

```
NSPoint point;
point.x = 10.0;
point.y = 20.0;
```

There is also a function, `NSMakePoint`, to create a point more easily:

```
NSPoint point = NSMakePoint(10.0, 20.0);
```

The `NSSize` structure represents a width and height and is defined as:

```
typedef struct _NSSize {
    CGFloat width;
    CGFloat height;
} NSSize;
```

There is also a function, `NSMakeSize`, to create a size more easily:

```
NSSize size = NSMakeSize(200.0, 100.0);
```

And finally, the `NSRect` structure is composed of both an `NSPoint` and `NSSize`, as such:

```
typedef struct _NSRect {
    NSPoint origin;
    NSSize size;
} NSRect;
```

The `origin` of a rectangle is in the lower-left corner, again. The function `NSMakeRect` allows you to create a rectangle more easily:

```
NSRect rect = NSMakeRect(0.0, 0.0, 200.0, 100.0);
```

Remember that you can chain access to structure members, so you could get the width of this rectangle as such:

```
CGFloat width = rect.size.width;
```

With these basic geometric data structures in hand, we can now begin to explore the geometry of views.

## NSView Geometry

A view is a rectangular area of a window. Each view has its own relative coordinate system. By default, the origin of a view is in its lower-left corner, too. A view tracks its size and location using two rectangles, the *bounds rectangle* and the *frame rectangle*.

The bounds rectangle represents the view's drawable rectangle in its own coordinate system and is retrieved using the `bounds` method:

```
NSView * view = ...;
NSRect bounds = [view bounds];
```

The origin of the bounds rectangle is almost always (0.0, 0.0). While you can change the origin, you typically leave it at (0.0, 0.0).

The frame rectangle represents the view's drawable rectangle from the perspective of its superview using the superview's coordinate system and is retrieved using the frame method:

```
NSView * view = ...;
NSRect frame = [view frame];
```

The size of the bounds and the frame rectangle is almost always the same. You can change the frame to move or resize the view within its superview, but, again, you typically don't need to change it once you set it up in Interface Builder. Figure 5 shows a view inside its superview. If the frame rectangle is at (5.0, 10.0), size (40.0, 20.0), the bounds is at (0.0, 0.0), size (40.0, 20.0).

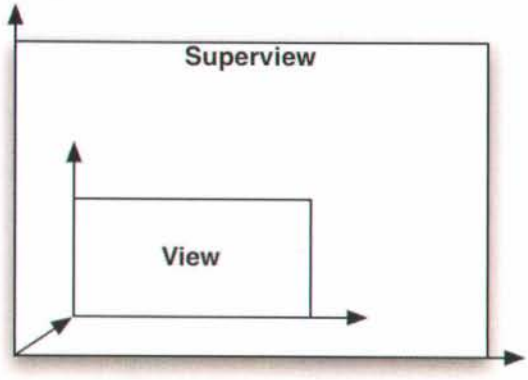


**Figure 5: Frame and bounds**

## Custom View Drawing

Enough theory. Let's dive into some real code. Create a new Cocoa Application from the Xcode New Project dialog. I'm calling my project CustomView. Now, create a new file, and select Cocoa > Objective-C NSView Subclass from the New File dialog box, as shown in Figure 6. Call the class CustomView.

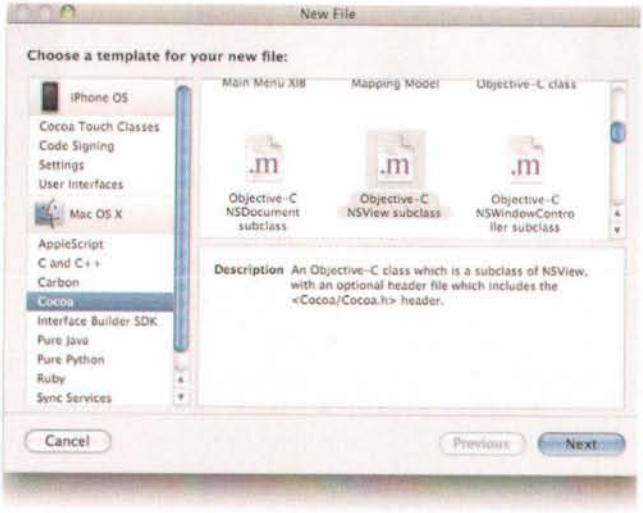


**Figure 6: New view class**

This file template automatically subclasses `NSView` and creates basic implementations of two methods: the `initWithFrame:` constructor and `drawRect:`. The `drawRect:` method is where you do any custom drawing. Change the CustomView.m file to match Listing 1.

### Listing 1: Revised CustomView.m

```
#import "CustomView.h"

@implementation CustomView

- (id)initWithFrame:(NSRect)frame {
    self = [super initWithFrame:frame];
    if (self == nil)
        return nil;

    // Initialization code here.
    return self;
}

- (void)drawRect:(NSRect)rect
{
    [[NSColor redColor] set];
    NSRectFill(rect);
}

@end
```

We're still leaving the constructor empty for now, but I've added two lines to the `drawRect:` method. The first statement changes the active color to red, and then we fill the entire bounds of the view using the current color. The result is that our entire view should be red. Of course, we need to put this view inside a window to actually test this out, so it's time to switch to Interface Builder.

Open up the MainWindow.xib file. Now find a custom view in the Library palette, as shown in Figure 7.

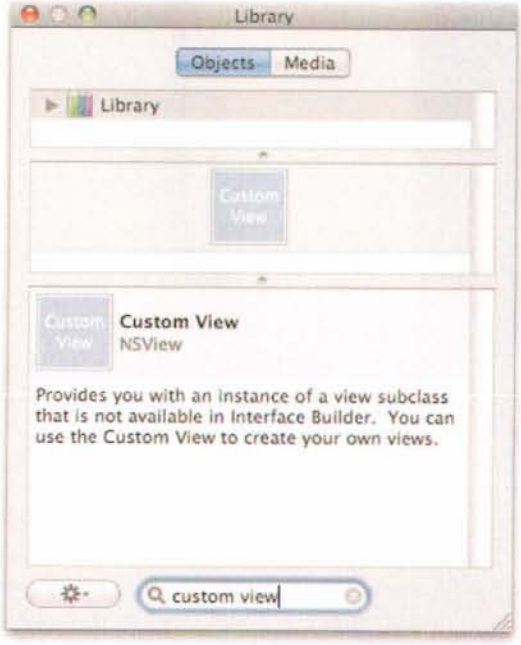


**Figure 7: Custom view in Library**

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Drag a custom view to your window and place it right in the center, as shown in Figure 8. Also change the autosizing so that the view will expand vertically and horizontally.

**Figure 8: Custom view placement**

Now, we need to tell Interface Builder that this view is really an instance of our `CustomView` class. Do this by switching to the **Identity** pane of the **Inspector** window and change the **Class** to be **CustomView**, as shown in Figure 9.

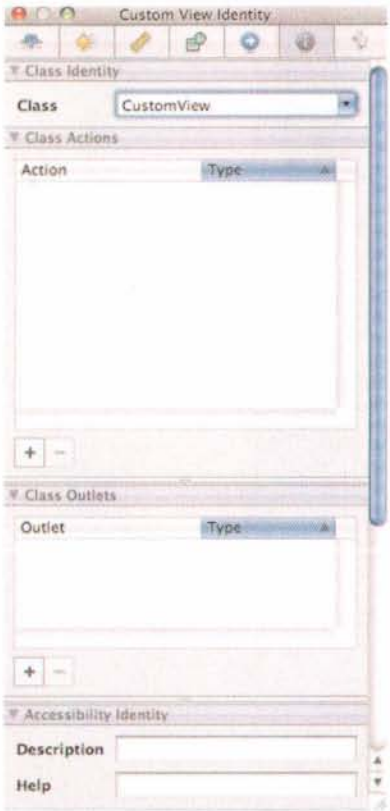



**Figure 9: Setting CustomView class**

Save the NIB, switch back to Xcode, and run the application. The view's rectangle should be red, as shown in Figure 10. Resizing the window should also resize the view.

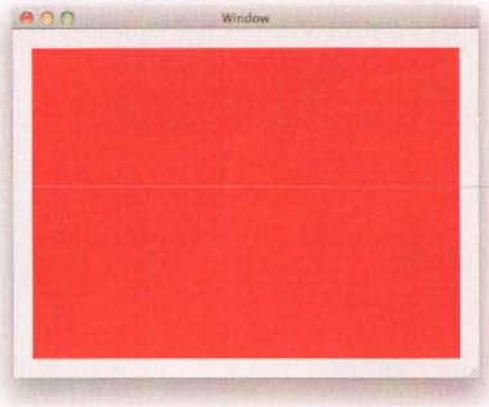



**Figure 10: Red custom view**

Congratulations! You've completed your first custom view.

## Drawing with NSBezierPath

What else can you draw besides a normal rectangle? The `NSBezierPath` class is a powerful class to draw all sorts of shapes. It has class methods to draw some of pre-defined shapes. Change `drawRect:` to this:

```
- (void)drawRect:(NSRect)rect
{
    NSRect bounds = [self bounds];
    NSBezierPath * path;

    [[NSColor redColor] set];
    NSRectFill(bounds);

    [[NSColor greenColor] set];
    path = [NSBezierPath bezierPathWithRoundedRect:bounds
                                           xRadius:75.0
                                           yRadius:75.0];
    [path fill];

    [[NSColor blueColor] set];
    path = [NSBezierPath bezierPathWithOvalInRect:bounds];
    [path fill];
}
```

We now draw a red rectangle, followed by a green rectangle with rounded corners, and finally a blue oval. The `fill` method of `NSBezierPath` fills the path using the current color, thus the end result is Figure 11.

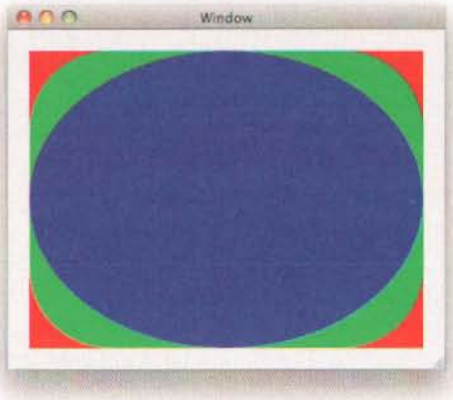



**Figure 11: Other shapes**

You can also create custom shapes by building your own `NSBezierPath`. That's a bit out of scope for this article, but feel free to read up and try out your own shapes. You can also draw images in your view using the `NSImage` class.

Note that we are currently ignoring the `rect` argument that's passed into `drawRect:`. This represents the partial rectangle of your view that needs to be redrawn. If your `drawRect:` method is very complicated and will take a long time to execute, you can use this argument to speed up your drawing by only drawing the sections of the view that need to be redrawn. Since our drawing is simple, we just draw the entire bounds every time and ignore this argument.

## Updating the View

Let's modify our `drawRect:` to just draw a rounded rectangle, but let's also make the color and corner radius configurable, stored instance variables. Modify CustomView.h to match Listing 2. Oh, and don't forget to enable garbage collection, if you haven't yet done so.

### Listing 2: CustomView.h with color and radius

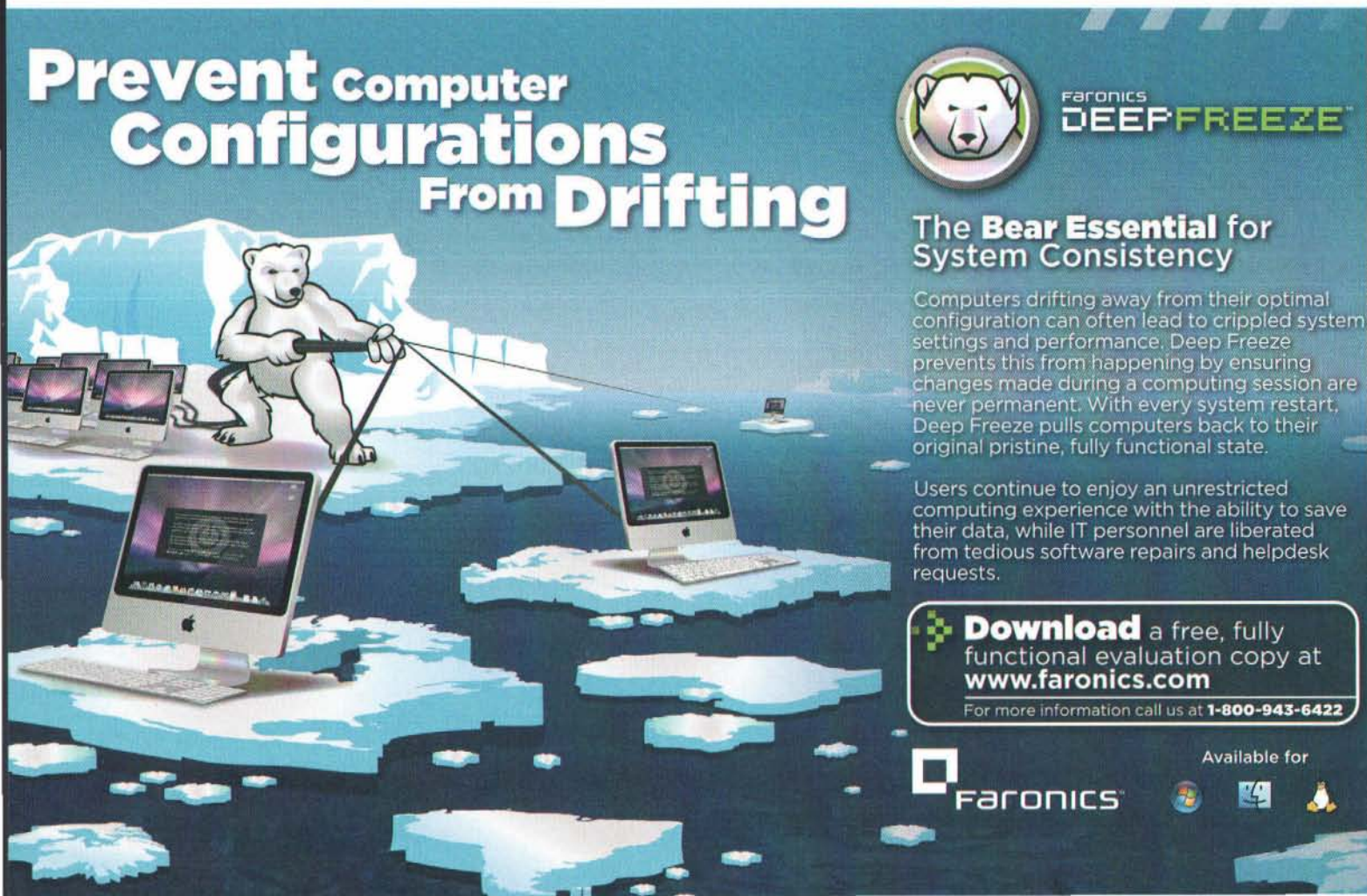
```
#import <Cocoa/Cocoa.h>


@interface CustomView : NSView
{
    NSColor * _color;
    CGFloat _radius;
}

@property (nonatomic, copy) NSColor * color;
@property (nonatomic) CGFloat radius;

@end
```

Now ordinarily, we would just use `@synthesize` to generate our getter and setter methods, but we have one issue. The system does not constantly call `drawRect:`, as a performance optimization. It only calls `drawRect:` when it thinks it needs to be redrawn, such as when the view is first shown or resized. However, we need to force our `drawRect:` to be called whenever the color or radius changes. The easiest way to do this is to provide custom setters.

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The naïve implementation would be to call `drawRect:` directly from the setters, but this will not work. The system generally only allows drawing at certain times, so instead, we mark our view as dirty by calling the `setNeedsDisplay:` method of `NSView` with a `YES` argument. The system will then call our `drawRect:` the next chance it gets. The full implementation is now Listing 3.

### Listing 3: CustomView.m with color and radius

```
#import "CustomView.h"


@implementation CustomView

@synthesize color = _color;
@synthesize radius = _radius;

- (id)initWithFrame:(NSRect)frame
{
    self = [super initWithFrame:frame];
    if (self == nil)
        return nil;

    _color = [NSColor redColor];
    _radius = 15.0;

    return self;
}

- (void)setColor:(NSColor *)color
{
    _color = [color copy];
    [self setNeedsDisplay:YES];
}

- (void)setRadius:(CGFloat)radius
{
    _radius = radius;
    [self setNeedsDisplay:YES];
}

- (void)drawRect:(NSRect)rect
{
    [_color set];

    NSRect bounds = [self bounds];
    NSBezierPath * path;
    path = [NSBezierPath bezierPathWithRoundedRect:bounds
                                           xRadius:_radius

yRadius:_radius];
    [path fill];
}

@end
```

Our custom view is now all set up with a configurable color and radius. We just need to update our user interface to allow the user to choose the radius and color. This means we also need a controller class. We could use Cocoa bindings, but I'll show the more explicit method using a custom controller.

Create a new `NSObject` subclass and call it `AppDelegate`. For the header file, we need to add an outlet to our view, along with two actions to set the color and radius, as shown in Listing 4.

### Listing 4: AppDelegate.h

```
#import <Cocoa/Cocoa.h>
```

```
@class CustomView;

@interface AppDelegate : NSObject
{
    CustomView * _customView;
}

@property (nonatomic) IBOutlet CustomView * customView;

- (IBAction)setRadius:(id)sender;
- (IBAction)setColor:(id)sender;

@end
```

The implementation is fairly straightforward. We just take the appropriate values from the sending control and update the custom view accordingly, as shown in Listing 5.

### Listing 5: AppDelegate.m

```
#import "AppDelegate.h"
#import "CustomView.h"

@implementation AppDelegate

@synthesize customView = _customView;

- (IBAction)setRadius:(id)sender
{
    CGFloat radius = [sender doubleValue];
    _customView.radius = radius;
}

- (IBAction)setColor:(id)sender
{
    NSColor * color = [sender color];
    _customView.color = color;
}

@end
```

Now, build the project to ensure you have no compile errors, and switch back to Interface Builder to modify the user interface and hookup our outlets and actions. Make the window a bit taller so we can add some controls at the bottom. Add a label, a slider, and a color well, as shown in Figure 12. For the slider, set the minimum, maximum, and current value to 0.0, 100.0, and 15.0, respectively. Also make sure to check the Continuous box so that we update the view in real time.

**Figure 12: Added controls**

Create an instance of the AppDelegate class and set it up to be the delegate of NSApplication. Set the customView outlet to the view in the window, the slider's action to be setRadius:, and the color well's action to setColor:.

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Save the NIB, and switch back to Xcode. Everything should be hooked up, and you should be able to run the application. Play around with moving the slider and changing the color. Your updates should take effect immediately. If you do not see the color and corner radius updates, make sure that Continuous is checked for both the slider and color well in Interface Builder and check your connections.

To see the effect of the `needsDisplay` flag, comment out the calls to `setNeedsDisplay:` and rerun the application. You should see updates only occur when you resize the window.

## Handling User Events

So far, we have only covered how custom views can draw their contents, but views can also accept user input, either from the mouse or keyboard. We are going to extend our view to draw a green circle wherever the user clicks their mouse. To implement this, we need to keep track of the circle's center point, so add an instance variable and property of type `NSPoint`, as shown in Listing 6.

### Listing 6: CustomView.h with circle center point

```
#import <Cocoa/Cocoa.h>

@interface CustomView : NSView
{
    NSColor * _color;
    CGFloat _radius;
    NSPoint _circleCenter;
}

@property (nonatomic, copy) NSColor * color;
@property (nonatomic) CGFloat radius;
@property (nonatomic) NSPoint circleCenter;

@end
```

Now, set the center point to be (50.0, 50.0) in the constructor and implement a custom setter that sets the `needsDisplay` flag, just as we did for the color and radius. Finally, update the `drawRect:` method to draw a green circle using the same radius as the rectangle corners. To draw a circle, we just need to draw an oval within a square. I've expanded out the circle's rectangle calculation to hopefully make this clearer:

```
- (void)drawRect:(NSRect)rect
{
    [_color set];

    NSRect bounds = [self bounds];
    NSBezierPath * path;
    path = [NSBezierPath bezierPathWithRoundedRect:bounds
xRadius:_radius
yRadius:_radius];
    [path fill];

    // Draw a green circle
    [[NSColor greenColor] set];
    NSRect circleRect;
    circleRect.origin.x = _circleCenter.x - _radius;
    circleRect.origin.y = _circleCenter.y - _radius;
    circleRect.size.width = _radius * 2.0;
    circleRect.size.height = _radius * 2.0;
    path = [NSBezierPath
bezierPathWithOvalInRect:circleRect];
    [path fill];
}
```

Handling mouse events is quite easy. Since `NSView` inherits from `NSResponder`, we just need to override a few methods. Let's start simple and handle mouse down events:

```
- (void)mouseDown:(NSEvent *)event
{
    NSPoint locationInWindow = [event locationInWindow];
    NSPoint locationInView = [self
convertPoint:locationInWindow
                                        fromView:nil];
    self.circleCenter = locationInView;
}
```

The `mouseDown:` method gets called when the mouse button is pushed down. The argument to this method is of type `NSEvent` and encapsulates all information about the current event. Not all methods of `NSEvent` are relevant to all types of events, but some methods of interest for mouse events are:

```
- (NSPoint)locationInWindow;
```

This method returns an `NSPoint` where the mouse was pressed down.

```
- (NSInteger)clickCount;
```

This method returns 1 for a single-click, 2 for double-click, and 3 for a triple-click.

We're going to use the `locationInWindow` to change the circle's center point. The tricky part is that we don't want the point in the window's coordinate system; we want it in our view's coordinate system. The `convertPoint:fromView:` method on `NSView` does this coordinate system conversion for us. If you pass in `nil` to the `fromView:` argument, it converts from the window's coordinate system. Once we get the location, we can use our setter to set the new center point. This, in turn, marks the view as needing redisplay.

If you run the application now, you should see the green circle move whenever the mouse is clicked. However, if you drag the mouse around, you'll notice the circle only moves to the starting point. I'd like to have the circle track the mouse when dragged.

The `mouseDown:` method only gets called when the mouse button is pushed down. There are separate event methods for mouse dragging and mouse up events. To ensure our center point tracks the mouse in all cases, we should implement these methods, too. Since the implementation for all three methods is the same, I've pulled it out into its own method:

```
- (void)setCircleCenterToEventLocation:(NSEvent *)event
{
```

```
    NSPoint locationInWindow = [event locationInWindow];
    NSPoint locationInView = [self
convertPoint:locationInWindow
                                        fromView:nil];
    self.circleCenter = locationInView;
}

- (void)mouseDown:(NSEvent *)event
{
    [self setCircleCenterToEventLocation:event];
}

- (void)mouseDragged:(NSEvent *)event
{
    [self setCircleCenterToEventLocation:event];
}

- (void)mouseUp:(NSEvent *)event
{
    [self setCircleCenterToEventLocation:event];
}
```

With these methods implemented, re-run the application and bask in the glory. You've now got a fully interactive view using custom drawing. A sample run is shown in Figure 13. The full code for `CustomView` is shown in Listing 7, in case you have trouble getting it to work. The final project is available for download on the MacTech website, as well.

**Figure 13: Green circle tracks mouse**

### Listing 7: CustomView.m, final

```
#import "CustomView.h"


@implementation CustomView

@synthesize color = _color;
@synthesize radius = _radius;
@synthesize circleCenter = _circleCenter;

- (id)initWithFrame:(NSRect)frame
{
    self = [super initWithFrame:frame];
    if (self == nil)
        return nil;
```

```
    _color = [NSColor redColor];
    _radius = 15.0;
    _circleCenter = NSMakePoint(50.0, 50.0);

    return self;
}

#pragma mark -
#pragma mark Accessors

- (void)setColor:(NSColor *)color
{
    _color = [color copy];
    [self setNeedsDisplay:YES];
}

- (void)setRadius:(CGFloat)radius
{
    _radius = radius;
    [self setNeedsDisplay:YES];
}

- (void)setCircleCenter:(NSPoint)circleCenter
{
    _circleCenter = circleCenter;
    [self setNeedsDisplay:YES];
}

#pragma mark -
#pragma mark Drawing

- (void)drawRect:(NSRect)rect
{
    [_color set];

    NSRect bounds = [self bounds];
    NSBezierPath * path;
    path = [NSBezierPath bezierPathWithRoundedRect:bounds
                                           xRadius:_radius
yRadius:_radius];
    [path fill];

    // Draw a green circle
    [[NSColor greenColor] set];
    NSRect circleRect;
    circleRect.origin.x = _circleCenter.x - _radius;
    circleRect.origin.y = _circleCenter.y - _radius;
    circleRect.size.width = _radius * 2.0;
    circleRect.size.height = _radius * 2.0;
    path = [NSBezierPath
bezierPathWithOvalInRect:circleRect];
    [path fill];
}

#pragma mark -
#pragma mark Events

- (void)setCircleCenterToEventLocation:(NSEvent *)event
{
    NSPoint locationInWindow = [event locationInWindow];
    NSPoint locationInView = [self
convertPoint:locationInWindow
                                    fromView:nil];
    self.circleCenter = locationInView;
}

- (void)mouseDown:(NSEvent *)event
{
    [self setCircleCenterToEventLocation:event];
}
```

---


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```
- (void)mouseDragged:(NSEvent *)event
{
    [self setCircleCenterToEventLocation:event];
}

- (void)mouseUp:(NSEvent *)event
{
    [self setCircleCenterToEventLocation:event];
}

@end
```

## Conclusion

The Cocoa view and responder classes make writing custom views fairly easy. All you have to do is subclass `NSView`, implement a few methods, and add your custom view to a window in Interface Builder. The rest is up to your imagination.

### About The Author

***Dave Dribin has been writing professional software for over eleven years. After five years programming embedded C in the telecom industry and a brief stint riding the Internet bubble, he decided to venture out on his own. Since 2001, he has been providing independent consulting services, and in 2006, he founded Bit Maki, Inc. Find out more at <http://www.bitmaki.com/> and <http://www.dribin.org/dave/>.***

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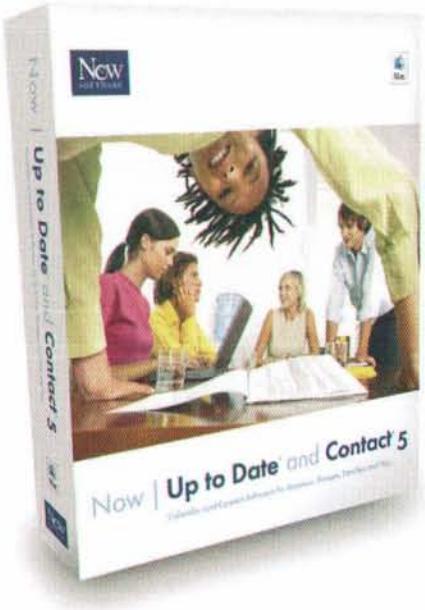


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# HEAD-TO-HEAD:

# Parallels Desktop VS. VMware Fusion

## How do VMware Fusion and Parallels Desktop for Mac stack up?

*By Neil Ticktin, Editor-in-Chief/Publisher*

## Why Virtualization?

A few years back, Apple switched the Mac platform from PowerPC to Intel processors. This introduced some interesting opportunities for the Mac, including the ability to run operating systems *other* than Mac OS X on a Mac. This includes not only your everyday Windows XP, but also other Windows OSes, including 64-bit versions, and a wide variety of Linux and other OSes.

You may already understand your options for running Windows on a Mac, but in case you don't, your first choice is to decide between Apple's Boot Camp and a virtualization product like VMware Fusion, or Parallels Desktop for Mac. With Apple's Boot Camp, you can run Windows natively, but you have to reboot every time you want to switch between Mac OS and Windows. In addition, you can only use one or the other OS at a time. That's not particularly convenient. For that reason, MacTech recommends a virtualization product for most users.

Virtualization gives "switchers" (those switching from Windows to Mac) more comfort because they can use their old applications, more easily get to old data, and in many cases, and it allows them to use some critical piece of software not available on the Mac. For example, your job may require you to run Internet Explorer, or Outlook, if that's all that your corporate systems support.

With virtualization, like what you'll see in Parallels Desktop for Mac or in VMware Fusion, you can run not only Windows, but other x86-based OSes alongside the Mac OS, getting the best of both worlds. For many, this may mean running the virtualized OS in a "window" on your Mac. Both VMware Fusion and Parallels Desktop also have the ability to run Windows applications even more transparently, but we'll leave that for another article.

## The Big Question

So which virtualization product do you choose? Which solution is faster? Should you run Windows XP or Vista? 32-bit or 64-bit? One virtual processor or more? In short, there are different answers for different people. It all depends on your needs.

To tackle this problem, MacTech undertook a *huge* benchmarking project starting a couple months ago. This is similar to the project that MacTech undertook over a year ago (See the February 2008 issue of *MacTech Magazine*). In both cases, as with other MacTech benchmarks, we tested performance of the types of things that everyday users typically do. Due to this, we limited the virtualized OS to Windows. In this case, it was not just testing the Windows OS performance, but also commonly used Windows applications. This time, we also added in something that many readers have requested: games! The goal was to see how VMware Fusion and Parallels Desktop performed, covering both Windows XP and Vista. Furthermore, we wanted to see some of the differences with larger memory configurations, as well as multiple processors and 64-bit versions of Windows.

Sounds simple enough, right? But when you start to realize that there were four different models of Macs, two virtualized environments, XP and Vista, some of which were 64-bit and multiprocessor, along with a whole slew of tests, each that had to be runs several times, there were over 2500 tests completed, timed *with a stopwatch*.

In fact, the testing took long enough that during the course of running these tests, both Parallels and VMware released minor updates, but we continued with one set of versions throughout for consistency.

To be clear, this article is *not* a product review; it's a benchmarking analysis (although we were morally obligated to comment on some of the games <g>). The article's purpose is to assess performance (including issues we found if something didn't work right), and not product features, graphics standards, user interface, OSes supported, etc. You should use feature and support information in conjunction with the below benchmarking results to make your product choice.

Given the magnitude of this project, we decided to give you the full version of this article online, and the conclusions here in print. (The full version would have taken 17 magazine pages, to give you an idea).

For the full article, with tons of graphs and category test results, see http://www.mactech.com/articles/mactech/Vol.25/25.04/VMBenchmarks/

## The Test Bench

When we were choosing computer models, we set out to choose the current models of Macs giving a good representation of what most people may have. Certainly, the faster models of these computers will perform faster than the models we used.

We chose four current Mac models to compare alongside each other: the "White" MacBook (Late 2008), MacBook Pro (Unibody), iMac, and Mac Pro.

The "White" MacBook was a 2GB RAM machine, running a 2.1 GHz Core 2 Duo processor. The MacBook Pro was the new "Unibody" model with 4GB RAM machine, running a 2.53 GHz Core 2 Duo processor. The iMac was a 2.66 GHz machine with 2GB of RAM. And, the Mac Pro was a 4GB RAM machine, running an eight-core configuration with 2.8 GHz processors.

For the 2GB machines, the virtual machines were set up with 1GB of RAM. The 4GB machines used 2GB for virtual machines. In all cases, except the File and Network IO tests, we used a fixed size disk to avoid any issues with disk fragmentation or other disk performance variations. File and Network IO tests used a dynamically sizing disk on a completely fresh installation of each product.

The tests compared VMware Fusion 2.0.1, with Parallels Desktop for Mac 4.0 (build 3540), running Mac OS X 10.5.5. (In reading the release notes of both Parallels Desktop 4.0 build 3810, and VMware Fusion 2.0.2, it does not appear that the changes in these versions would significantly alter the performance results we found.) All required Windows updates were installed for each version.

Both VMware Fusion and Parallels Desktop were configured so that the virtual machines optimized performance for the virtual machine (and not Mac OS X). *[Ed. Note: VMware told* MacTech *that due to a bug in Mac OS X 10.5.4, VMware Fusion ignored this setting and only optimized for the virtual machine to avoid crash/data loss. Apple fixed this bug in 10.5.5, so VMware now uses the option in 2.0.2. Bottom line: While none of this affects the testing, if you are running VMware, update your OS and VMware Fusion to the most current version.]*

## Test Types

There are a variety of often referred to, and utilized benchmarking suites in the computer industry including SPEC tests, PCMark, Unixbench and others. Each of these tests uses a series of tests that measure in a consistent way to assess specific types of performances. The key to each of these tests is appropriateness, repeatability, and accuracy.

When testing virtual machines, however, using outside utilities within a virtualized environment can provide strange and incorrect results. For example, there are many issues with



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internal timers not displaying measurements accurately, and some suites don't work at all in a virtual machine environment. Instead, MacTech chose to create a suite of tests that would mimic what many users would do in normal use, but stick to those actions that were repeatable, and measurable with a stopwatch. After all, if you couldn't perceive a difference with a stopwatch, the user is not likely to perceive it at all.

To that end, there are several kinds of tests that we ran: "Performance" including launch and CPU tests, File and Network IO, Footprint, Application Launch, Application Performance, and 3D and HD Graphics.

## Overview

We won't keep you in suspense. In the majority of overall averages of our tests, Parallels Desktop is the clear winner running 14-20% faster than VMware Fusion. The one exception is for those that need to run Windows XP, 32-bit on 2 virtual processors, VMware Fusion runs about 10% faster than Parallels Desktop.

The overall conclusions are shown in **Figure 1** on the following page, but you should really look at more of the detail to understand what works best for you. (Note: In all cases except battery life, when looking at the graphs in this article, take note that shorter bars are better.)

For 32-bit Windows OSes, running under a single virtual processor (the default when you create virtual machines in either product, and therefore, the most commonly used configuration), Parallels Desktop runs both XP and Vista 14% faster than VMware Fusion. (Comparing 3 types of VM launch times, compression, transcoding MP3, 7 types of file and network IO, 3 types of application launches, and 3 application performance tests.)

For 32-bit Windows OSes, running under two virtual processors, VMware Fusion runs XP 10% faster than Parallels Desktop, and Parallels Desktop runs Vista 20% faster than VMware Fusion. (Comparing 3 types of VM launch times, compression, transcoding MP3, 3 types of application launches, and 3 application performance tests.)

For 64-bit Windows Vista, running under two virtual processors, Parallels Desktop runs 15% faster than VMware Fusion. (Compares 3 types of VM launch times, compression, and transcoding MP3.)

| OS/Environment | Result |
|---|---|
| Windows XP, 32-bit, 1 Processor | Parallels Desktop runs 14% faster |
| Windows Vista, 32-bit, 1 Processor | Parallels Desktop runs 14% faster |
| Windows XP, 32-bit, 2 Processors | VMware Fusion runs 10% faster |
| Windows Vista, 32-bit, 2 Processors | Parallels Desktop runs 20% faster |
| Windows XP, 64-bit, 2 Processors | Parallels Desktop runs 15% faster |

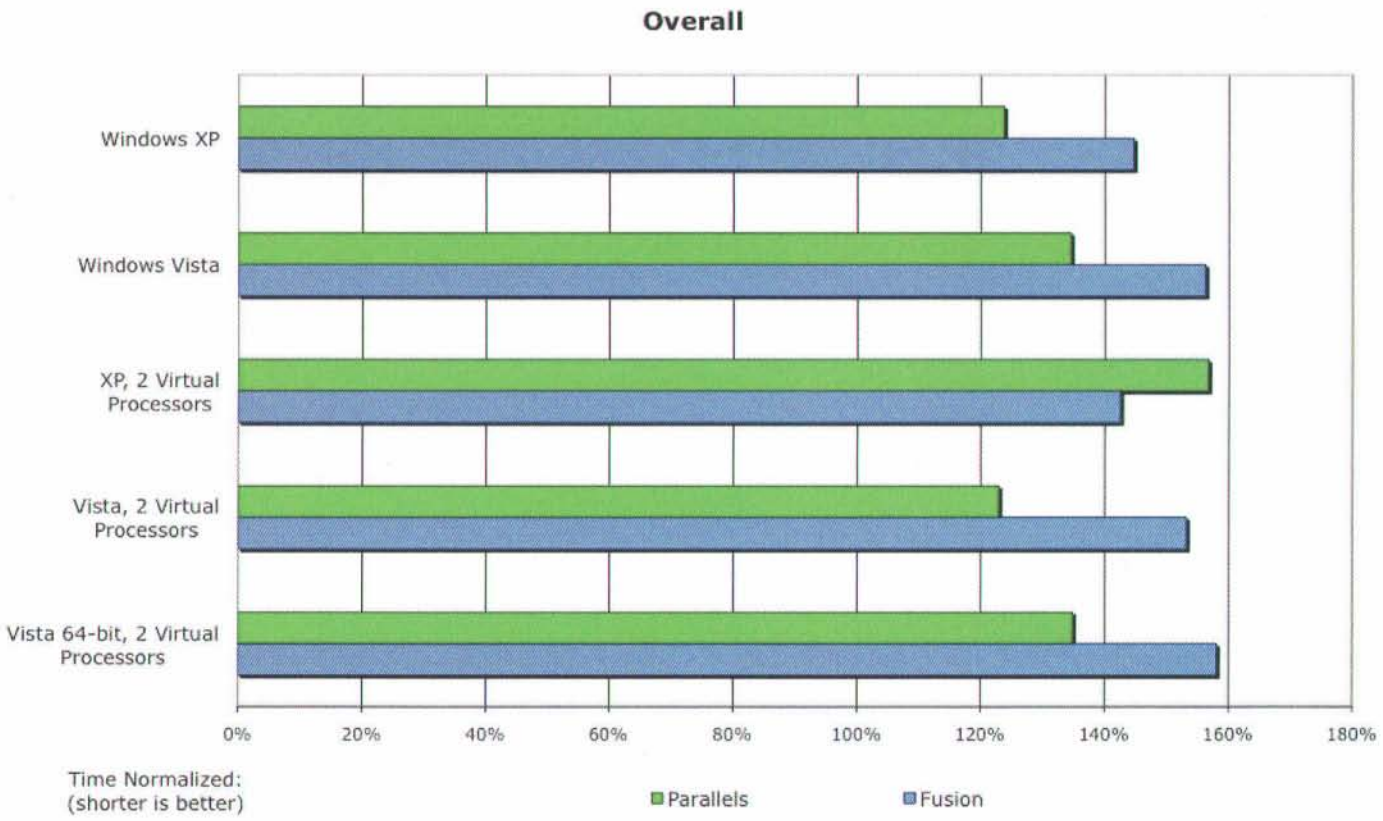


**Figure 1: Overall Results, Parallels Desktop vs. VMware Fusion**

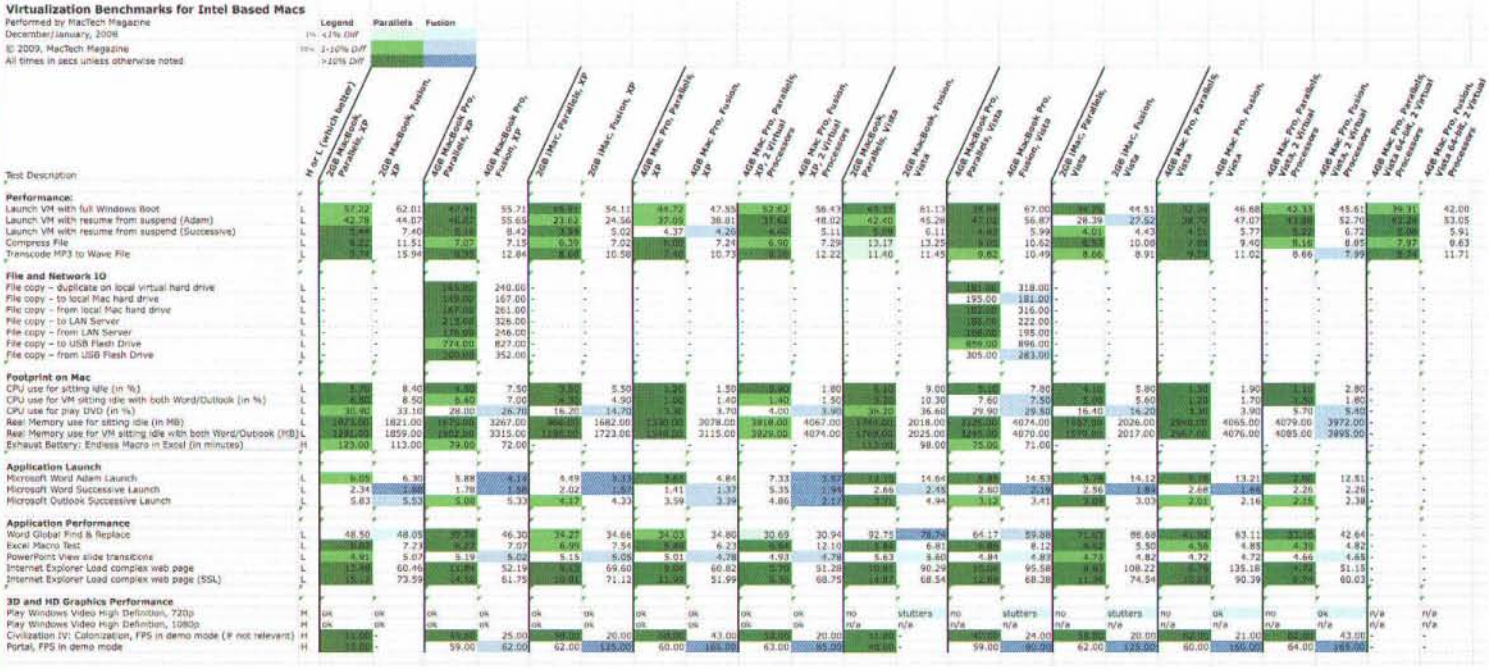


**Figure 2: Test Results Matrix with Coloring**
**(Note: This is not intended to be read, but to give you an overview of results by coloring. Download the full spreadsheet at ftp://ftp.mactech.com/src/mactech/volume25_2009)**

Another way to look at this is the color-coding on the results matrix in **Figure 2**. Green cell coloring means Parallels Desktop was faster than VMware Fusion. Blue cell coloring indicates VMware Fusion was faster than Parallels Desktop. Darkest coloring means faster by 10% or more, medium coloring indicates 1-10% difference, and lightest coloring means less than 1% difference. (Note: Not all tests were run on all configurations, hence the empty cells.)

One thing to note: VMware Fusion was several times slower than Parallels Desktop in the Internet Explorer tests (across the board), so we removed IE from the overall analysis to avoid skewing the overall results. See more on this in the Internet Explorer section below.

## The Test Suite and Results

In the full version of the article, we walk you through what we tested, and the results for each. These tests are designed to arm you with information to help you make the best decision for your type of use.

For each set of results, you can see the analysis for each model of computer for XP, and for Vista. If you want to see more detail for multiple processors, 64-bit, or on an individual Mac model, you can review the spreadsheet for those details.

For the launch tests (launching the VM, Windows, and Applications), we had the option of an "Adam" test, and a "Successive" test. Adam tests are when the computer has been completely restarted (hence avoiding caching). Successive tests are repeated tests without restarting the machine in between tests, and can benefit from caching. Both mimic real use situations.

The tests used were selected specifically to give a real-world view of what VMware Fusion and Parallels Desktop are like to run for many users. We eliminated those tests that we ran which were so short in time frame (e.g., fast) that we could not create statistically significant results, or that had imperceivable differences.

For some of the analysis, we "normalized" results by dividing the result by the fastest result for that test across all the machine configurations. We did this specifically so that we could make comparisons across different groups, and to be able to give you overview results combining a series of types of tests, and computer models.

Instead of a plain "average" or "mean", overall conclusions are done using a "geomean", which is a specific type of average that focuses on the central results and minimizes outliers. Geomean is the same averaging methodology used by SPEC tests, PCMark, Unixbench, and others, and it helps prevent against minor result skewing. (If you are interested in how it differs from a mean, instead of adding the set of numbers and then dividing the sum by the count of numbers in the set, $n$, the

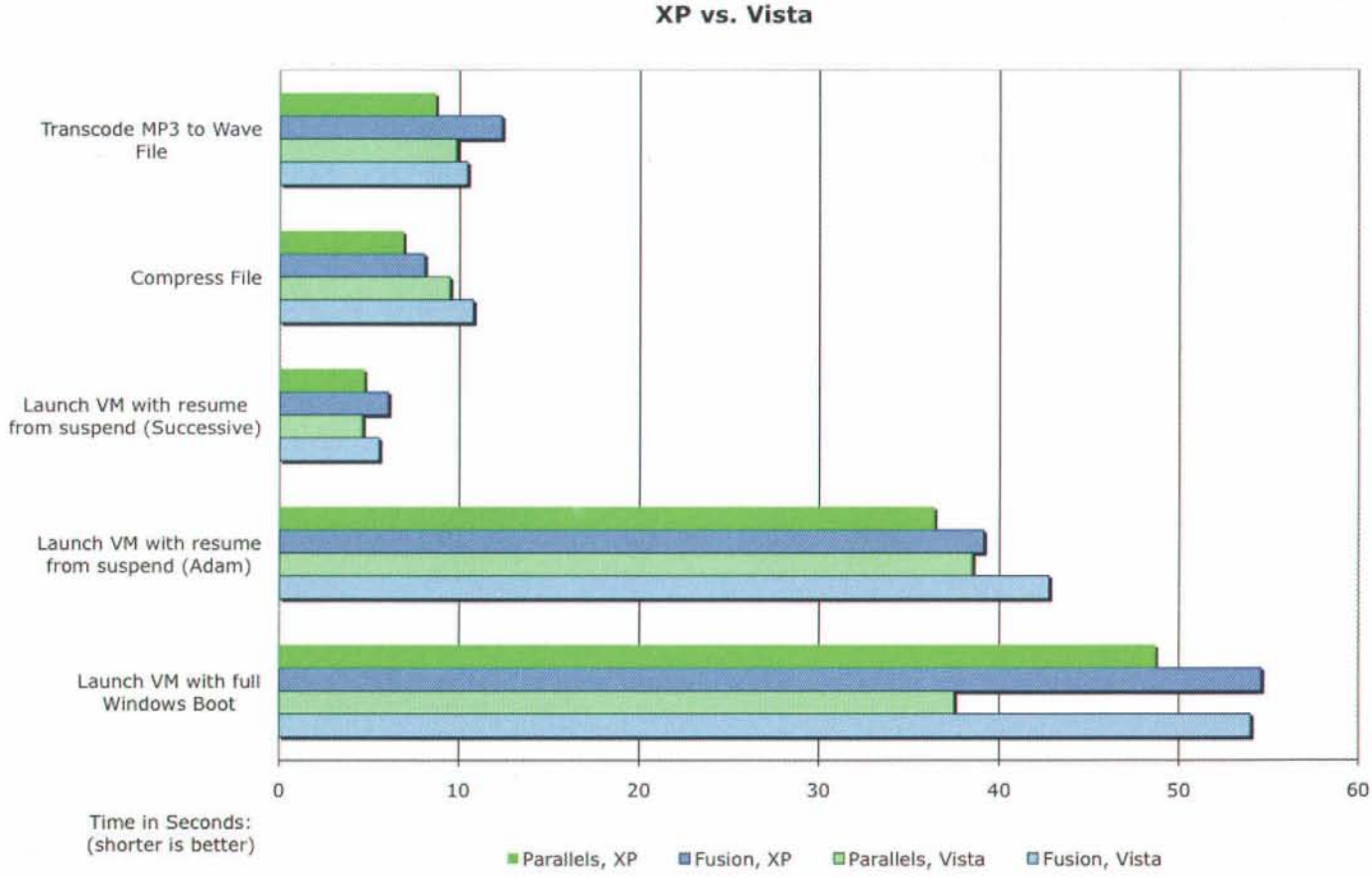


**Figure 3: Windows XP vs. Windows Vista Performance**

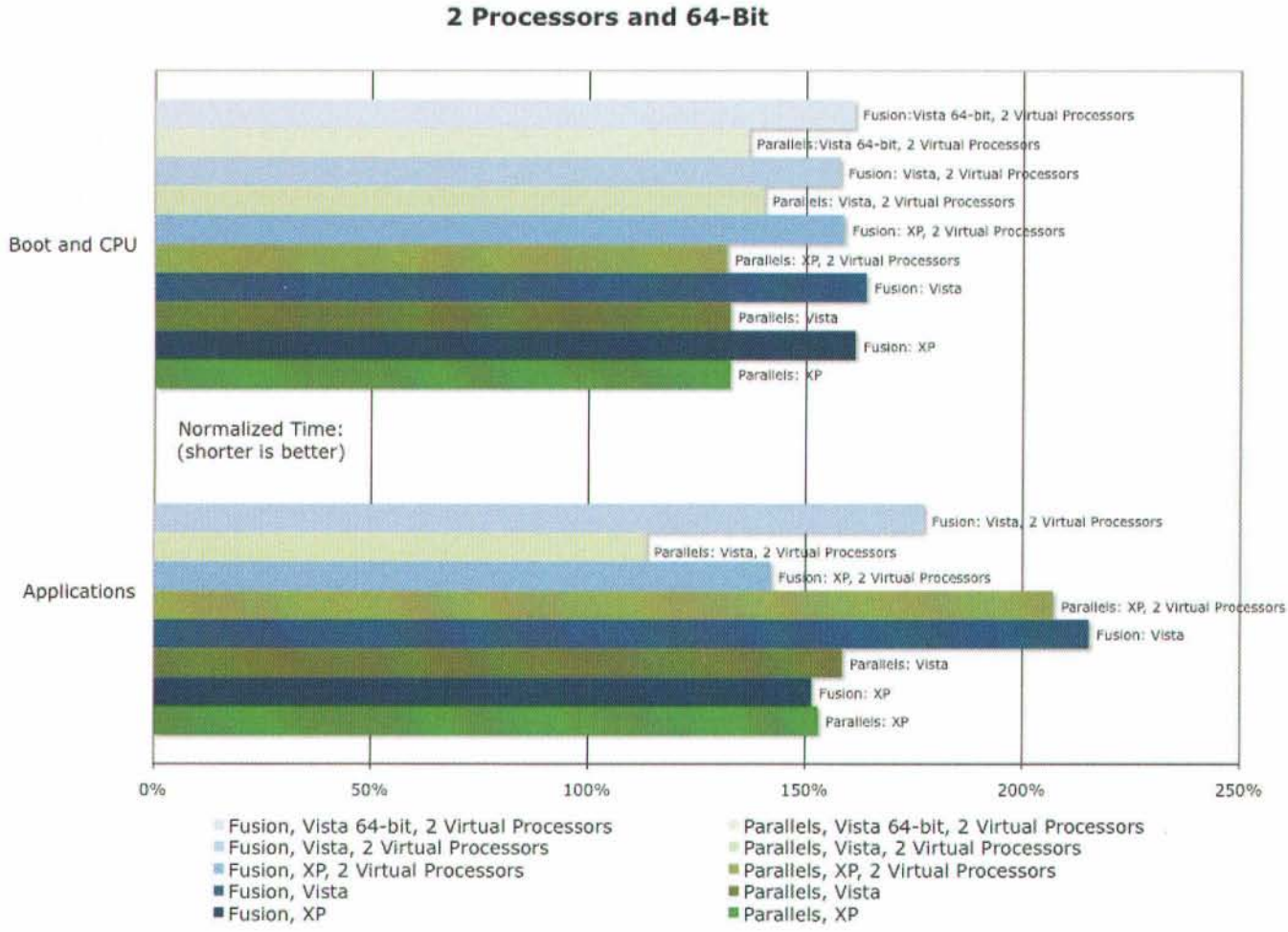


**Figure 4: Multiple Virtual Processors, 64-bit Performance**

numbers are multiplied and then the *n*th root of the resulting product is taken.)

For those interested in the benchmarking methodologies, see the more detailed testing information in Appendix A. For the detailed results of the tests used for the analysis, see Appendix B. Both appendices are available on the MacTech web site.

# Additional Conclusions

There are additional conclusions that we can extract from the results as well. Specifically, we looked at the differences between XP and Vista, as well as multiple virtual processors and 64-bit Vista.

## XP vs. Vista

In our last virtualization benchmarking article, there was a significant difference between running Microsoft XP vs. Microsoft Vista. Now, the difference is much less significant, in fact, while XP continues to be faster for most things, it's probably not enough to matter. You should make your choice based on which OS you want. That said, anecdotally, we find XP under virtualization to be far more stable, and definitely less annoying to run. See Figure 3.

## Multiple Virtual Processors and 64-bit

There's a big push right now for multiple virtual processors and 64-bit Windows. And, while there are times that you may need them, most people will not.

Multiple virtual processors are helpful for when you have a computationally intensive application, and you need to split the work. The types of applications that you normally would need this for include video, Photoshop, CAD, etc... Frankly, if speed is that important to you, you should be asking yourself about whether to run the app native on your Mac instead of in a virtual machine. Sometimes, like for CAD, you may not have an option. Take note, however, Microsoft has limitations in their user license on the number of processors you are running. While Parallels Desktop supports multiple cores up to two quad core virtual processors, VMware Fusion supports only multiple virtual processors, not multiple virtual cores. As a result, we could only test both up to two virtual CPUs under Windows.

64-bit is another issue. Primarily, your big benefit here is that you can address a whole lot more memory. For most virtualization users, this is likely not relevant. Many of the

Windows applications and drivers still are not 64-bit compatible, and there are all kinds of reports of issues. This is the future of where Windows is going, but it's not necessary for most users.

That said, we wanted to give you a look at what performance looked like for both of these for what most people probably run: Windows, Microsoft Office, and Internet Explorer. As you can see, while there's some difference, you have to judge if it's enough to be worthwhile. For most, 32-bit XP is likely adequate (see Figure 4).

## Conclusion

Both VMware Fusion and Parallels Desktop for Mac are excellent products, and both allow you to run Windows XP and Vista quite well. In the end, your decision as to which product you should take into account what's most important to you: speed, footprint, graphics capabilities, features, user interface, OS you want to run, and more all come into play.

While the Vista "penalty" that we saw in prior tests is now mostly gone (presumably because both Vista SP1 made improvements as well as both of these virtualization products), we would advise that you stick with Windows XP given how much better it runs overall (not to mention how much less annoying it is).

When it comes to whether you should use multiple processors or 64-bit virtual machines that depends on your use. If you have a real need for either, and can articulate a reason for it, than use them. They do work well. That said, if you don't have a specific need, then don't bother, it's not worth it; just stick with Windows XP on a single virtual processor.

Many people have the feeling of "more is better," but clearly when it comes to RAM in the virtual machine, that is not necessarily the case. More RAM means longer virtual machine launch times, suspends and resumes. For most users, 1GB of virtual machine RAM will work best. Use more than that only if you really know you need it.

And, here's how things look in general terms for each of the test suites that we ran:

| Test Suite | Performance Winner |
|---|---|
| Windows Launch Performance | Parallels Desktop |
| CPU Performance | Parallels Desktop |
| File and Network IO | Parallels Desktop, except for 2 of the 14 tests |
| Footprint on Mac | Parallels Desktop, especially in RAM footprint |
| Application Launch | VMware Fusion |
| Application Performance | Both did well, except for Internet Explorer where Parallels Desktop was several times faster |
| 3D and HD Graphics Performance | See gaming section online |

In the majority of overall averages of our tests, Parallels Desktop is the clear winner, running 14-20% faster than VMware Fusion. The one exception is for those that need to run Windows XP, 32-bit on 2 virtual processors, VMware Fusion runs about 10% faster than Parallels Desktop.

And, while both products these days have very little CPU footprint, Parallels Desktop had a surprisingly small RAM footprint, which was actually typically lower than the amount of RAM configured for the virtual machine. Presumably, once Windows actually needed more of the allocated RAM, the actual footprint on the Mac would increase.

Finally, for gamers, experiences will differ with each game. In our tests, MacBook users will have a better experience with Parallels Desktop, presumably because of the lower end graphics capabilities of the hardware. Beyond that, you should look at each game and what the feedback from users from both the Parallels and VMware communities.

One thing is clear, given the track record, expect Parallels Desktop and VMware Fusion to both keep getting better and better.

MT

## About The Author


***Neil is the Editor-in-Chief and Publisher of MacTech Magazine. Neil has been in the Mac industry since 1985, has developed software, written documentation, and been heading up the magazine since 1992. When Neil does a benchmark article, he likes to test the features that people will use in real-life scenario and then write about that experience from the user point of view. Drop him a line at publisher@mactech.com***

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# THE MACTECH SPOTLIGHT: Robert Kuilman

http://halfduplex.net/

**Do you work for a company or are you self-employed?**

I am a Business Administration Student at Twente University in the Netherlands. I used to be a Computer Science student but decided to switch when I realized it makes sense to focus on what you're not good at. As every student I am always in need of money, so combining the knowledge from my Business Administration and Computer Science studies, I took to selling my software under the name of halfduplex.net, as that was the domain I already owned.

**What do you do?**

Being an independent developer I have to do everything myself. Development, promotion, accounting and customer support are all tasks that I am familiar with. This seems a bit much for one person to do, but it has its benefits. I always know what's going on with development, what the latest promotional activities are and will make sure customers get the best treatment possible. I might have to look for personnel when the business continues to grow, though.

**How long have you been doing what you do?**

I've been writing software since I was 8 or 9. It first started out in GW-BASIC on MS-DOS, and over time have progressed to writing Objective-C code. Those first lines of code didn't do anything useful, as any programmer can tell you. But it was tons of fun. It was mostly due to my dad who figured I could be doing something more constructive with my time behind the computer than play Pac-Man.

**Your first computer:**

My first computer to write code on must have been my dad's Amstrad PC 1640, running MS-DOS. It was a great machine and took all the ignorant and abusive stuff I threw at it as a young kid without complaining. The first computer owned by myself was an Apple Macintosh LC II, a great computer and fun to work with. One day in middle school I had to give a presentation on my hobbies. I just put the Mac in my backpack along with some magazines and went to school. The LC II's design allowed me to take it apart in front of class without any tools and explain in detail how it all works together. I aced the presentation.

**Are you Mac-only, or a multi-platform person?**

These days I'm a Mac-only person, no doubt about it.

**What is the advice you'd give to someone trying to get into this line of work today?**

Respond to customer's needs and actively promote your product. I've worked with customers on some complex problems when using my software. This has improved my software a lot, which benefits everyone, and you'll see customers appreciate the extra attention they get. Promotion is essential because if no one knows you are out there, how will they find you? When I started sending out press releases and actively seeking out review opportunities the sales increased immediately.

Also, when you develop software for the Mac, make software that is Mac-like. A good interface and intuitive workflow will make a better impression than an application that scares users from the first minute by overloading them with options and a workflow that is very non-Mac like.

**What's the coolest tech thing you've done using OS X?**

Back when OS X was still in its beta phase I wrote a P2P client much like gnutella and a little bit later, I wrote mail server software. Neither really came off the ground because of a lack of experience in, I guess almost every aspect of distributing software, but it was still pretty cool. Mac OS X's Cocoa allows developers to get results very quickly and try out a lot of crazy ideas, I love that.

**Where can we see a sample of your work?**

My primary product is Media Catalog, which you can download at http://halfduplex.net/ In 2005 I wrote the 1.0 release of Family ( http://saltatory.com/ ) which is something I am still very proud of.

**The next way I'm going to impact IT/OS X/the Mac universe is:**

There are a lot of tasks you and I do everyday that can be done with a lot more ease. I can't tell you what my exact role will be, but I want to help getting that realized.

**MT**

***If you or someone you know belongs in the MacTech Spotlight, let us know! Send details to editorial@mactech.com***

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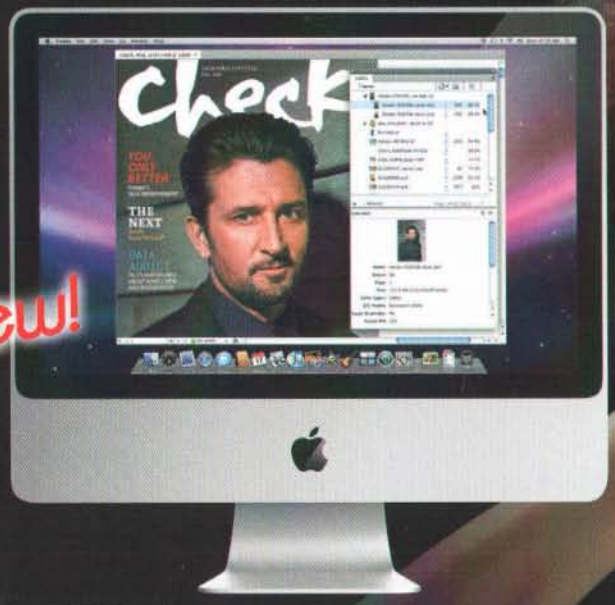


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